Relationship of the verbal fluency index profile with the variables age, educational level, and sex in a group of schoolchildren

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ABSTRACT

This is a quantitative, descriptive, cross-sectional, and correlational study, whose purpose was to relate the profile of the verbal fluency index-VFI with the variables of age, sex, and educational level of a schoolchildren group from an official educational institution in the department of Sucre, Colombia. The sample consisted of 390 students distributed in 176 of BPE and 214 of BSE to whom the verbal fluency test reviewed by Ardilla and Rosselli (2007) was administered. The Microsoft Excel 19.0 statistical program was used for data coding and the EZAnalyze version 2.5 add-in was used for processing. The results showed that the phonological verbal fluency, semantic, and general index tests were below the normative mean. The association between the VFI with the variables age and school grade was confirmed with the parametric test of Pearson's coefficient with a high level of significance p=0.000. However, gender had no influence on performance because there was no correlation. It is concluded that the VFI increases with age and school grade, factors that imply that as they increase, it will allow a progressive tendency to access the lexicon, the ability to name words according to phonemic indication, and from a given category.

Keywords: phonological verbal fluency, semantic verbal fluency, verbal fluency index, school children.

1. Introduction

Verbal fluency-VF determines the linguistic ability that allows a person to spontaneously produce ideas and concepts with agility, establishing an association of words with meaning, allowing to determine the speed and ease of verbal production. Likewise, it assesses language functions, mental organization, search strategies, retrieval mechanisms, lexical-semantic store, short, long-term, and working memory and influences performance, attention, and vigilance (Ramirez et al., 2005 as cited in Lopez, 2018).

The VF allows the semantic variant exploration-SVF which consists of accessing words inclusive to a specific category involving lexical-semantic processing and verbal memory, and the phonological type - PVF requires producing words with the initial sound indication of a vowel or consonant phoneme for which decoding and encoding of information, lexical representations, verbal retrieval and self-monitoring of responses are required (Velasco, 2020). Therefore, VF allows the cognitive plasticity assessment and organizational strategies (Henry and Crawford, 2004) demanding executive functions (Hirshorn and Thompson, 2006). Thus, VF skills have been studied in child populations with attention deficit hyperactivity disorder - ADHD, Turner syndrome, developmental dyslexia, and cognitive disability (Fumagalli et al., 2017, Hurks et al., 2004 as cited in Alvarez, 2021).

The systematic review of the scientific evidence on the subject with schoolchildren indicates a higher research proportion with the sociodemographic variables of age and educational level (Lozano and Ostrosky, 2006) demonstrating that the results in VF assessments improve proportionally with advancing age

increasing significantly in childhood and adolescence specifying that VFS increases mainly in children from 8 to 15 years old and is related to the progressive development of comprehension level and meaning (Matute et al., 2004, Casals-Coll et al., 2013). However, infants at the age of 10 years could reach a performance like a young adult's (Anderson et al., 2001, Klenberg et al., 2001). Nevertheless, studies with the sex variable find contradictory results, in some cases, female gender represented a significant indicator (Soriano et al., 2015, Cea and Ríos, 2017) while in others it does not represent any incidence (Casals-Coll et al., 2013). In addition, a positive relationship was found between VF and the time the mother interacts with the child, attitudes, parental educational level, and reading habits. Ardila et al., 2005, Resh et al., 2014 as cited in Alvarez, 2021).

Now, scores below normative means on VF tests may indicate compromises in communicative language skills reflecting poor discourse quality that is complexified by context, intentionality, and interlocutor affect (UNR, 2014). Consequently, low VF produces difficulties in oral and literate language, due to a lack of development in the receptive channel's activation for interpretation and motor mechanisms of word articulation, fundamental elements for school learning (Caicedo, 2016). Therefore, it is of vital importance that in educational institutions actions for the promotion and communicative health maintenance are developed, whose justification introduces the pressing need for the work of the speech therapist to design identification and intervention programs with the support of teachers to mitigate language disorders in students. Therefore, the research purpose study was aimed at relating the profile of the verbal fluency index with age, sex, and educational level of a schoolchildren group of the educational institution Liceo Carmelo Percy Vergara from Corozal, Sucre, identifying the phonological fluency degree, semantic, general index, and association between the variables.

2. Materials and methods

The research was framed under a quantitative approach with a non-experimental, descriptive,

transversal, and correlational design since it comprises the description, registration, analysis, and interpretation of the current nature (Tamayo, 2006). The population is composed of 1,252 students from the Educational Institution Liceo Carmelo Percy Vergara, the main seat is in Corozal. It selected a non-probabilistic intentional sample by the convenience of 390 students distributed in 176 of BPE with a mean age of 7.90 (SD: 1.82) and 214 of BSE with 14.02 (SD: 1.96), who met the following inclusion criteria: students attached to the educational institution who are registered in the academic enrollment system. On the contrary, students with cognitive and/or hearing disabilities were excluded.

To achieve the objectives, the educational institution was approached through a face-to-face meeting with the rector and the school counselor to authorize the study execution with the purpose of filling out the respective permissions and accessing the students' information condensed in the academic enrollment system, databases and clinical histories of the speech therapy service. Likewise, an interview was established with the parents to sign the informed consent in accordance with the ethical regulation stipulations in research with human beings in Colombia determined by resolution 008430 of the Ministry of Health and Social Protection (1993), which establishes the scientific, technical, and administrative standards at international level and the ethical principles of the Declaration of Helsinki (2013).

The verbal fluency test was administered according to the review of Ardilla and Rosselli (2007) with the purpose to be quickly and globally evaluating the language of the population sample under study based on the phonological condition of the words production with the phonemes /f, a, s/ and semantics with the categories of animals, fruits, and actions in a determined time of one minute to establish the verbal fluency index-VFI. For the analysis of the results, the normative data for the Colombian population of Ardilla et al. (1994) were used for educational groups of age range, considering the normative scores criteria.

The statistical program Microsoft Excel 19.0 was used for coding and the EZAnalyze version 2.5 add-in was used for processing. The quantitative variables were then analyzed, estimating the

descriptive statistics of central tendency and variability by calculating the mean, standard deviation, and normative values (objectives 1, 2, and 3). For the inferential analysis of the three variables, a type of parametric statistical correlation was performed using Pearson's coefficient (objective 4).

3. Results

The application results of the phonological and semantic verbal fluency test, general index, and association between the variables age, sex, and educational level of a schoolchildren group are described, based on the objectives of the study.

Table 1 shows that the BSE achieved performance in the PVF test with an overall mean and standard deviation of 24.40 (8.94) with specific scores in the word tasks with the labiodental-fricative phoneme /f/ of 7.5 (3.36), with the central vowel phoneme /a/ of 8.84 (3.36), and with the alveolar-fricative phoneme /s/ of 8.09 (3.37). Likewise, the BPE findings with an X: 10.56- SD: 8.19 and in the word subtests with the phoneme /f/ of 2.96 (2.71), with the phoneme /a/ of 4.06 (3.36), and with the phoneme /s/ of 3.57 (3.01).

Table 1. Descriptive statistics of phonological verbal fluency test results of schoolchildren

Grade Level	F		A		S		PVF	
	X	SD	X	SD	X	SD	X	SD
0°	0.18	0.50	0.59	0.00	0.68	0.89	1.45	1.37
1°	1.13	1.07	1.93	1.92	1.76	1.54	4.83	3.86
2°	2.33	2.23	3.11	2.91	2.44	2.40	7.88	6.47
3°	3.64	2.76	5.25	3.75	4.29	2.75	13.19	7.84
4°	4.40	2.34	5.54	2.46	5.40	2.29	15.34	5.55
5°	4.93	2.68	6.45	3.24	5.58	3.53	16.87	8.28
BPE	**2.96**	**2.71**	**4.04**	**3.38**	**3.57**	**3.01**	**10.56**	**8.19**
6°	5.86	2.54	7.29	2.85	7.24	3.04	20.40	6.93
7°	6.12	2.57	6.63	2.84	6.30	2.83	18.97	7.27
8°	6.93	3.14	8.80	3.46	7.50	2.95	23.23	8.29
9°	7.86	3.28	8.71	3.36	8.52	3.03	25.05	8.33
10°	8.21	3.66	10.56	3.47	8.73	3.64	27.46	8.75
11°	9.61	3.34	10.71	3.49	9.84	3.57	30.17	8.90
BSE	**7.5**	**3.36**	**8.84**	**3.57**	**8.09**	**3.37**	**24.40**	**8.94**

Table 2 details the BSE results showed a performance in the SVF test of an X of 33.45 and SD of 9.12 with a specific development in the AFA words subtask with the semantic category of animals of 14.26(4.26), fruits of 10.45(3.03) and actions of 8.72(4.31). However, in the students of

grades 4° BPE, 7° and 11° BSE certain variations in the scores were evidenced that impede the performance progression course due to the presence of multiple errors observed in the time elapsed between the stimulus-response with latency-type inhibitions in 45.71% (16) of 4°, 42.42% (14) of 7° and in 53.84% (21). In the BPE in the FVS test an X: 20.77- SD: 7.73 with a detail

in the AFA subtest of animals with a 9.23 (3.76), fruits of 6.79 (2.90) and actions of 4.90 (3.26). In addition, it is determined that in the inclusive of words with the semantic condition of animals, the schoolchildren achieved a better performance in each of the educational grade levels.

Table 2. Descriptive statistics of the semantic verbal fluency test results of schoolchildren

GRADE LEVEL	A		F		A		SVF	
	X	SD	X	SD	X	SD	X	SD
0°	5.68	2.41	4.63	2.40	5.22	3.28	15.54	6.69
1°	8.26	3.35	4.96	2.12	3.36	2.10	16.16	5.07
2°	9.44	2.92	6.22	2.42	5.07	2.84	20.74	5.77
3°	10.54	3.54	7.83	2.75	5.64	4.38	24.06	7.55
4°	8.91	3.23	7.91	2.72	5.20	2.68	21.98	6.66
5°	11.58	4.23	8.29	2.79	4.93	3.55	24.35	9.46
BPE	**9.23**	**3.76**	**6.79**	**2.90**	**4.90**	**3.26**	**20.77**	**7.73**
6°	12.56	3.87	9.02	2.30	6.51	2.35	28.18	6.47
7°	11.69	3.75	9.51	2.69	7.90	3.87	29.12	8.15
8°	13.3	4.14	10.53	3.08	7.30	4.37	31.13	8.48
9°	14.39	3.34	10.31	3.00	8.50	4.37	33.16	8.01
10°	16.67	4.80	11.81	3.05	9.62	3.90	38.11	8.89
11°	16.35	3.07	11.41	3.18	11.97	4.51	39.74	8.31
BSE	**14.26**	**4.24**	**10.45**	**3.03**	**8.72**	**4.31**	**33.45**	**9.12**

Table 3 shows the verbal fluency profile index of the BSE with a score equivalent to an X of 57.67 and SD of 16.28 and BPE with an X of 31.00 and SD of 14.03. It demonstrates a difference in performance in the two groups with a marked rise towards better values for high school students and especially with superior performance in the SVF task. However, according to the FV test normative data, the overall VFI and the specific PVF and SVF scores are below average. Likewise, certain failures in the stimulus-response time in the PVF

test due to errors related to the phonological form in 56.81% (100) and perseverations in 23.86% (42), and in the BSE phonological perseverative process in 19.91, 43% (48) and inhibitory due to latencies in the responses in 51.45% (124). In addition, in the FVS test in the BPE processes of latencies in response access in 45.45% (80) and semantic perseverations in 21.02% (37) and in the BSE in 50% (100) instructions due to failures in the typicality of lexical referents.

Table 3. Descriptive statistics of the verbal fluency profile index of schoolchildren.

FV TEST	SCHOOL CHILDREN	X	SD	NORMATOIVE DATA
PVF	BPE	10.56	8.19	19.30
	BSE	24.40	8.94	34.65
SVF	BPE	20.77	7.73	20.10
	BSE	33.45	9.12	29.75
VFI	BPE	31.00	14.03	39.40
	BSE	57.67	16.28	64.40

Table 4 establishes the relationship between the VFI with the variables age, sex, and school grade based on Pearson's coefficient. The findings showed a high level of positive significance of $p=0.000$ indicating a moderate statistical probability of correlation occurrence with the variable age given that r= value between 0.445 and 0.426 and school grade of r= 0.487 and 0.601 in the VFI in the grades, establishing a directly proportional dependence between the variables age/school grade, a factor that implies that to the extent that they increase it will allow a better performance of the students in the VFI and in their specific tasks of PVF and SVF. However, it is determined that the sex variable does not influence performance because it shows a null relationship and a negative significance level.

Table 4. Pearson's coefficient parametric statistics for the correlation between the VFI with the variables age, sex, and school grade.

Schoolchildren	IFV (X)	Age		Sex		Grade level	
		r	p	r	p	r	p
BPE	31.00	0.445	0.000*	-0.139	0.066	0.601	0.000 *
BSE	57.67	0. 426	0.000*	-0.021	0.760	0.487	0.000*

4. Discussion

Regarding the students' PVF results and SVF level, a tendency towards increased performance was established with better performance in the BSE. In addition, they obtained a superior performance in the SVF task. Thus, school-aged children achieve superior performance in FVS tasks than PVF, findings that agree with the research results of Brocki & Bohlin, 2004; Matute et al., 2004; García et al., 2012; García Coni & Vivas, 2014; Valencia et al., 2000 as cited in Fumagalli et al., 2017. However, both groups of students did not reach the normative mean and evidenced the presence of errors in the response time to the stimulus due to latency-type inhibitions, excitatory perseverative phonological, and semantic. Thus, it is demonstrated that the deficits in the SVF are verified in the total word production, cluster number, and discontinuous switches. Also, in the PVF in the word global emissions number, intrusions, perseverations,

cluster number, and discontinuous switches, highlighting that differences were observed in the PVF determining that the optimal performance of the VF tasks is based on the clustering main process that requires relatively automatic cognitive processes related to the semantic memory and the lexical store. Likewise, the switching demands of executive functions require a greater cognitive effort determined by the initiation and/or flexibility of word search and retrieval processes (Raoux et.al., 2008; Troyer et al., 1997 as cited in Rubiales et al., 2013). It evidences the majority presence of latencies in the semantic categories of animals, fruits, vegetables, and names and phonological interruptions in the fricative /f/ and vowel phonemes /a/. (Nogueira et al., 2016). That is why, in the tests that evaluate VF, it is generally observed that the SVF is more developed than the PVF, which implies a greater capacity for controlled and programmed verbal production with an optimal organization of responses; likewise, the SVF would be related to memory skills, executive function, and planning (Augruso et al., 2010). Therefore, the generation of words according to phonological principles is a complex process in which strategic search and organization skills are required to suppress the habit of using and evoking words in a way related to their meaning. In contrast, evocation according to semantic criteria is based merely on the associations of the words meaning in which their retrieval is simpler (Perret, 1974, Riva et al., 2000, Hurks et al., 2006 as cited in Arán, 2011).

Similarly, in VF it is common the presence of the phenomenon called "tip of the tongue"-TOT, which refers to relatively frequent transient states in which the neurologically normal speaker does not access the desired word with the required speed during verbal production. Therefore, the latencies obtained could be attributed to typicality factors of the referents or their abstraction degree that influence the retrieval stage of the conceptual word representations, while the size of the description units affected the retrieval of their phonological form (Hernández, 2004). In addition, in the phonological access to determine words that begin with a particular letter in the FAS test, a greater facility and performance for the retrieval with the phoneme /a/ is highlighted, and in the AFA test in the specific animal's category, which

indicates that it is the most used vowel in the Spanish language and is present in the vocabulary in their every day and the inclusive of animals in the students' environment. (Almeda, 2005 as cited in Nogueira et al., 2016). Likewise, the font choice and semantic category used in the VF assessment modulate performance (Pino et al., 2021). In addition, education factors, culture, and socioeconomic status strongly condition categorization and learned reservoirs (Rubiales et al., 2016).

Now, the general findings of the students' VFI profile determined a positive significance level indicating a correlation high probability with age and school grade in both groups, establishing a directly proportional relationship that affects test performance. Thus, it is justified that the increasing ascent curve increases with the evolution of the VFI, it suggests that the older the age, the greater the positive effect on verbal fluency skills (Fumagalli, 2017; Kavé, 2016; García et al., 2012; and Lozano and Ostrosky, 2006). Therefore, VF increases in childhood and adolescence (Matute et al., 2004). Thus, the IFV showed a better performance in the BSE at an average of 14 years, a period in which an important cognitive development degree and metalinguistic skills should be established, verifying the scores by the semantic progression and language phonological structures (Bernstein, 1989 and Rivas et al. 2000 as cited in Lozano and Ostrosky, 2006). Along the same lines, schooling in youngsters favors the development of the functions such as semantic memory, lexical accessibility, planning, organization and verbal production, task initiation, working memory, selective attention, and search strategies (Romero et al., 2019).

However, the relationship of the VFI with the sex variable evidenced a null and significantly negative dependence which is consistent with certain research systematic review studies (Zanín et al., 2010, Casals-Coll et al., 2011, Domínguez, et al., 2018). However, females/girls present better verbal skills, especially in verbal fluency tasks, episodic memory, and phoneme recognition, outperforming males/boys in phonological fluency but not in semantics, for which the sex/gender difference appeared to be category

dependent. Although, there may be considerable variation suggests other contributing factors, such as language, country/region, and socioeconomic stratum of participants (Soriano et al, 2015; Cea and Ríos, 2017; Bruno, 2019; Hirnstein et al., 2022).

5. Conclusions

In summary, the PVF, SVF, and VFI test results did not reach the normative mean according to the primary and secondary school grades. It is possibly due to the multiple errors presence of latency-type inhibitions, excitatory semantic/phonological perseverations, and the "tip of the tongue" phenomenon that occurs in the response time according to the stimulus in both tests. Specifically, a better performance was obtained in the tasks with the vowel phoneme /a/ and in the inclusive of the semantic category animals. As for the association of the variables, a high level of significance was established, determining a directly proportional relationship. It indicates that as the variables increase, they will allow a tendency to facilitate access to the phonological and semantic lexicon by means of oral instruction.

Conflict of Interest

They declare that they have no conflict of interest in this article.

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