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DIMENSIONS OF TEMPERAMENT IN ADULTS WITH CHRONIC STUTTERING IN THE LIGHT OF I. P. PAVLOV'S THEORIES

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The aim of the study was to determine dimensions of temperament in adults with chronic stuttering in the light of Pavlov's temperament typology. The test sample consists of a (1) clinical group—adults with chronic stuttering ($N = 202$); and (2) a criterion group—adults with normal speech fluency ($N = 198$). The Pavlovian Temperament Survey (PTS) by Strelau and Zawadzki and our own survey were administered. Stutterers, compared to subjects with normal speech fluency, are characterized by a lower level of the excitation process, mobility and balance of nervous processes; they also tend to exhibit a higher level of the inhibition process. The severity of stuttering, the age at which the first symptoms of speech disfluency occur, treatment, evaluation of its effectiveness and intention to undergo therapy do not differentiate stutterers in terms of the considered temperament traits. The temperamental factors of chronic stuttering as per Pavlov's typology are: increased reactivity to stimuli, reduced ability to adapt to new situations, the ability to flexibly respond to changing conditions, a weak type of the nervous system (lower strength of the excitation process, weaker mobility of the nervous processes), which makes it difficult to cope with challenges encountered and increases susceptibility to mental disorders.

Keywords: temperament; Pavlov; chronic stuttering; adults.

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Temperament is a set of traits pertaining to formal behavioral traits such as sensory responsiveness to stimuli from the environment and emotional sensitivity (Strelau, 2006). It takes part in regulating the interaction between an individual and the outside world. In many theories, temperamental traits are attributed to specific adaptive functions because they affect the socialization process and contribute to the development of many elements of the personality structure. They may also lead to the formation of characteristic disorders (Rothbart et al., 2001; Wiltink et al., 2006).

Rothbart et al. (2001) defines temperament as "constitutionally based individual differences in reactivity and self-regulation". In this definition, "reactivity" refers to the arousal of physiological and sensory response systems, and "self-regulation" is a process that can modulate (facilitate or inhibit) its reactivity. In turn, "constitutional" defines the biological basis of an individual, which is influenced by genetics, maturation and experience (Rothbart et al., 2001).

The Role of Temperament in the Development of Stuttering

Temperament has been found to affect intellectual development (Miceli et al., 1998), school achievement (Martin et al., 1988) and adaptation (Kyrios & Prior, 1990). The relationship between temperament and language development disorders was also studied. Certain temperament traits have been shown to cause delayed speech development and other speech disorders (Eisenberg et al., 2004; Hauner et al., 2005). Many authors claim that temperament as a whole, as well as its individual dimensions, may be a factor contributing both to the development and maintenance of stuttering (Anderson et al., 2003; Guitar, 2003; Howell et al., 2008; Tichenor & Yaruss, 2020). Some of these dimensions are: excessive focus of attention, difficulty in dealing with emotions, low tolerance to frustration (Riley & Ingham, 2000). It has been found that children with a higher level of reactivity respond more negatively to their disfluency (Eggers et al., 2021). Research results also often confirm that stutterers are characterized by high reactivity (Caprara & Cervone, 2000; Guitar, 2003; Zebrowski & Conture, 1989).

According to Alm and Risberg (2007) and Karrass et al. (2006), the relationship between temperament and stuttering results from the fact that higher reactivity is the cause of a greater level of neuromuscular tension, excessive muscle reflexes and difficulties in regulating the rhythm and speaking speed (Alm & Risberg, 2007; Karrass et al., 2006). Increased reactivity makes the activation threshold much lower and the responses to stimuli stronger, which results in faster fatigue and disorganization of verbal behavior (Aron & Aron, 1997).

In the studies conducted in the adult population using the Adult Temperament Questionnaire (ATQ), it was observed that people exhibiting difficulties in speech fluency compared to non-stuttering individuals obtained lower results in terms of positive affect, but the size of the trend was moderate. At the same time, it was found that an increased frustration correlated with reduced knowledge about stuttering, but the relationship between temperament traits and stuttering frequency was not confirmed (Lucey et al., 2019). In other studies involving adults, a higher mean amplitude of the acoustic startle response was found in stutterers than in individuals who did not reveal difficulties in speech fluency (Guitar, 2003), but these results were not confirmed in the empirical work of (Elliset al., 2008). In turn, Alm and Risberg found that the acoustic amplitude of surprise was not significantly associated with anxiety or reactive temperament (Alm & Risberg, 2007).

Pavlov's Typology of Temperament

There are also premises suggesting that the low strength of the nervous system, according to Pavlov's typology of temperament (1951–1952), may be a factor determining the occurrence of problems with fluency in speaking, especially in situations implying stress (Furnham & Davis, 2004). According to the above-mentioned approach, individual differences in terms of temperamental traits are conditioned by certain properties of nerve processes, which we infer on the basis of human behavior and response. Pavlov (1951–1952) distinguished four innate (therefore relatively resistant to environmental influences) properties of the central nervous system: strength of excitation, strength of inhibition, mobility, and balance of nervous processes. He did not investigate what neurophysiological mechanisms underlie these properties, but focused on their functional significance (Pavlov, 1952; Strelau, 2001).

The strength of excitation is a feature of the nervous system expressed in the ability of nerve cells to work, i.e. to withstand long-term or short, but strong stimulation without slipping into so-called protective inhibition. It appears when the strength of the stimulus exceeds the efficiency of nerve cells, thus protecting them from the harmful effects of the stimulus. When protective inhibition occurs, the law of force stops working (reflex strength is a function of stimulus strength), and inadequacy of the reaction occurs, such as the disappearance of the reaction or its reduction. The strength of the excitation process, therefore, determines the strength of the nervous system. The stronger the nervous system, the smaller the process of stimulation and subsequent inhibition (Strelau, 2006; Teplov & Nebylitzyn, 1966). In individuals with a weak type of nervous system there is a decrease in effectiveness under the influence of strong or long-term stimulation. Strong emotional tension and stress

cause that they react inadequately to the requirements, and social burdens cause functional disorders. They show features of emotional lability and a tendency for long-term persistence of emotional states. They prefer to perform activities that are not very demanding and short-term, because they are not resistant to fatigue (Pavlov, 1951–1952; Strelau & Zawadzki, 1998).

The strength of the inhibition process is the ease with which the nervous system creates conditional inhibition responses. They manifest themselves as the ability to refrain from various types of reactions (e.g., emotional expression), delay, postpone or interrupt specific activities when required. The high force of the conditional inhibition process facilitates behavior control. People with a weak inhibition process produce conditional inhibition reflexes with great difficulty. They are also unable to maintain inhibition for a long time, as this can lead to behavioral disorders and sometimes even neurosis (Bodunov, 1993; Strelau, 2001).

The balance of nervous processes has the status of a secondary feature of the nervous system. It is the equilibrium between the processes of excitation and inhibition. The significance of this trait is revealed in situations where it is necessary to inhibit certain stimulations to create a place for others, adequate to the emerging stimuli (Strelau, 1997; Strelau & Zawadzki, 1998).

The mobility of nervous processes is the ability to respond adequately and quickly to changing stimuli or life situations. Adequate mobility means that the nervous system can change one excitation to another or the excitation process into inhibition and vice versa. People who are characterized by low mobility of nerve processes do not like frequent and rapid changes. They adapt to new situations and environments with difficulty, and their moods tend to persist for a long period of time (Strelau, 2006; Teplov & Nebylitzyn, 1966).

Referring the model of temperament proposed by Pavlov (1951–1952) to the specifics of stuttering, it should be emphasized that problems with speech fluency arise as a result of the interaction of biological, linguistic, psychological and social factors (Tarkowski, 2018). An important role is played by temperament, perceived both as one of the leading predictors of problems with speech fluency, and as a factor that may intensify this type of difficulty, and that is why it is important to distinguish the properties of the central nervous system that are characteristic of people who stutter, based on—neglected in current research—the typology of Pavlov (Druker et al., 2019; Furnham & Davis, 2004). Chronic stuttering does occur in adults and poor motivation for therapy is a disquieting fact. Therapy is seen as grueling and ineffective. Possibly a source of frustration is that individual characteristics, including those of temperament, are not taken into account.

The review of empirical works indicates that the issue of temperamental factors related to stuttering remains open. Although the available research indicates the

importance of individual temperament traits in the emergence and development of problems with speech fluency, they mainly concern children, which justifies the need for this type of analysis in the adult population (Howell, 2004; Rothbart et al., 2001). The second premise for undertaking research in this area is the postulate of Furnham and Davis (2004). When reviewing empirical papers devoted to the temperament of stuttering people, they observed that none of the publications includes the Eastern European temperament theories, which indicates that these typologies should be the theoretical foundations of future research, and in particular the typology of temperament proposed by Pavlov. As already mentioned, the low strength of the nervous system may be a factor implying problems with fluency in speaking, especially in the situations that trigger stress. Besides, therapeutic success is less likely to occur in stuttering people with a weak type of nervous system (Pavlov, 1952; Strelau, 2001).

The Present Study

The aim of the study was to determine dimensions of temperament in adults with chronic stuttering in the light of Pavlov's temperament typology. The analysis of the literature showed that no such research has been carried out so far.

METHOD

Participants

The research sample was collected based on intentional choice and consisted of two groups of adults. The first one consisted of subjects with chronic stuttering (clinical group, $N = 202$; 50.5%), and the other consisted of individuals who did not present problems with speech fluency (criterion group, $N = 198$; 49.5%). The basic criterion for selecting stutterers was age (from 18), developmental stuttering, and its permanence. People in the clinical group were 18 to 63 years old ($M = 30.98$, $SD = 11.26$). People from the criterion group were between 19 and 60 years old ($M = 29.03$, $SD = 12.20$). A comparative analysis shows that the considered groups were homogeneous in terms of age ($t = 1.66$, $p = .097$).

Detailed sociodemographic characteristics of the studied groups are presented in Table 1. Nearly three-quarters of the subjects in the clinical and criterion groups were men. More than half of the participants in each group were single. The highest percentage of people stuttering and those not revealing difficulties with speech flu-

ency came from small towns. The largest number of respondents in the clinical and criterion groups had completed secondary education, and the smallest number had elementary education. Comparative analyses showed that the groups were homogeneous in terms of gender, marital status, place of residence, and level of education.

Table 1

Sociodemographic Characteristics of Studied Groups

Variables		Group				Group comparison	
		Clinical		Criterion			
		N	%	*N*	%	χ^2	*p*
Gender	woman	58	28.7	53	26.8		
	man	144	71.3	145	73.2	0.19	.664
Marital status	widow/single	118	58.4	122	61.6		
	in a relationship	84	41.6	76	38.4	0.43	.514
Place of residence	village	51	25.2	62	31.3		
	town*	82	40.6	74	37.4		
	city**	69	34.2	62	31.3	1.82	.403
Education	elementary	10	5.0	10	5.1		
	vocational	42	20.8	34	17.2		
	secondary	87	43.1	105	53.0		
	higher	63	31.2	49	24.7	4.24	.237

Note. * ≤ 25,000 inhabitants; ** > 25,000 inhabitants.

The detailed characteristics of the stuttering clinical group are presented in Table 2. All subjects had begun to stutter in early childhood, on average at 4.53 years (*SD* = 1.56). The study population was dominated by people who had been stuttering since the age of three. On average, they had been suffering from speech fluency disorders for over 26 years (*M* = 26.49, *SD* = 11.44). Over half of the respondents showed moderate symptoms of stuttering and were treated for this. However, most of them were not satisfied with the results of the therapy, and nearly three-quarters of them indicated that they were not going to undergo therapy because of problems with speech fluency.

Table 2
Characteristics of the Stuttering Clinical Group

Variables		*N*	%
Year of life in which stuttering occurred	third	75	37.1
	fourth	45	22.3
	fifth	29	14.4
	sixth	15	7.4
	seventh	38	18.8
Severity of stuttering symptoms, according to SSI procedure (Riley, 1972)	mild	73	36.1
	moderate	112	55.4
	severe	17	8.4
Stuttering treatment	yes	103	51.0
	no	99	49.0
Assessment of the effects of stuttering treatment	positive	39	37.9
	negative	64	62.1
Intention to treat stuttering	yes	56	27.7
	no	146	72.3

Measures

The Pavlovian Temperament Survey (PTS) by Strelau and Zawadzki (1998) and a survey of the authors' own design were used for the research (Strelau & Zawadzki, 1998).

The PTS questionnaire was used to measure behavioral manifestations of the strength of excitation (SPP), the strength of the inhibition process (SPH), and mobility of nerve processes (RPN), and secondarily also the balance of nerve processes (RWN). This is a tool with great international popularity, used in about 20 countries. Its popularity stems from the fact that it is the only questionnaire that allows measuring temperamental traits in accordance with Pavlov's model (Strelau & Zawadzki, 1998). The PTS has satisfactory internal consistency and stability. The tool's validity has been positively verified by the correlation of its scores with other tools for measuring temperament and personality, research on the genetic conditioning of traits measured by the PTS, and factor analyses. It consists of 57 statements (19 for each scale). The subject responds to each of them by choosing an answer on the scale from 1 (*I strongly agree*) to 4 (*I strongly disagree*). The results of the

RWN scale are obtained by calculating the ratio between SPP and SPH. A score of 0 and +2 is interpreted as a balance of nerve processes, and anything above this as an imbalance with a predominance of the excitation process. A negative result indicates an imbalance of nerve processes with a predominance of inhibition. PTS is used in scientific research and psychological practice, especially in educational and vocational counseling, because it can be used to predict the functioning of respondents in difficult situations (Strelau & Zawadzki, 1998).

A survey of our own design was used to collect basic sociodemographic data of the respondents (gender, age, marital status, place of residence, education) and information on the nature of stuttering in persons revealing problems with speech fluency (age in which stuttering occurred for the first time; severity of symptoms, treatment; evaluation of the effects of treatment; treatment intention).

Procedure

The study was conducted in two stages.

Stage 1

During our seminars on stuttering, participants (certified speech pathologists) developed a case study for a stuttering adult. They were to reach out to such a person in their environment and conduct individual tests. The person selected for the study considered themselves as one who stutters and had a diagnosis of stuttering at some stage of their life. Then, the task of the examiner was to talk freely with them (on any topic, for at least 0.5 hours) and record it with a camera. This sample was used to definitively confirm speech disfluency. Then the respondent completed the PTS questionnaire and a survey. Additionally, the task of the students of our seminars was to examine an adult without impaired fluency in speaking, of a similar age, with similar education, and of the same sex as the stutterer. In the criterion group, only the PTS questionnaire together with the survey were administered (Strelau & Zawadzki, 1998). The students gave their written consent to prepare the project and use it for scientific purposes.

Stage 2

The recordings of stutterers were evaluated to determine the severity of stuttering by three competent judges (speech pathologists, university employees), in accordance with the SSI procedure (Riley, 1972). Only people who were fully consistent in the assessment were selected for further analysis. Adults were classified as stutterers when they demonstrated four or more signs of disfluency in speaking (e.g., repetition of sounds or syllables, sound dragging) per 100 words of conversational speech and obtained an overall score of six or higher in SSI. Those who scored 30 or more were rejected because there were only five of them.

In this way, persons with mild, moderate and severe levels of stuttering underwent further analysis. After selection based on speech sample analysis and PTS completeness, some of the subjects were rejected. From 240 pairs of studies, 204 stutterers and 200 subjects in the criterion group were selected.

For all those qualified for the study the native language was Polish. All were informed about the purpose of the study and gave their written consent to participate in it. They did not suffer from hearing, neurological, or psychiatric disorders and were not under the care of a psychologist or psychiatrist.

Statistical Tools

Statistical calculations were performed using IBM SPSS 24 software. The description of the examined sample was based on mean values, standard deviation, minimum and maximum quantitative variables and percentage distributions of the qualitative data frequency. In order to assess the level of homogeneity of the studied groups both the chi-square and Student's *t*-tests for independent data were used. The distribution shapes of the parameters were evaluated using the Kolmogorov–Smirnov test. To verify the intergroup differences, Student's parametric *t*-test and one-way analysis of variance (ANOVA) with Tukey's multiple comparison test were used. In the work, the boundary point of committing a type I error is .05, while the results included in the range $.05 < p < .1$ were described as significant at the level of statistical tendency.

RESULTS

We started our analysis of the temperamental factors of chronic stuttering in the adult population by identifying the temperamental traits characteristic of the analysed population, which make them different from the women and men with normal speech fluency. The results of the intergroup comparisons are presented in Table 3. The analyses show that, in comparison to the respondents in the criterion group, stutterers are characterized by lower strength of the nervous system, mobility and balance of nervous processes.

Table 3

Temperament Traits of Researched Individuals

Scale	Group				Group comparison	
	Clinical		Criterion			
	M	*SD*	*M*	*SD*	*t*	*p*
Strength of excitation process	47.05	8.25	50.95	7.09	5.06	.001
Strength of inhibition process	50.87	6.14	49.57	7.71	1.87	.063
Mobility of nerve processes	50.44	8.42	54.37	5.49	5.52	.001
Balance of nerve processes	0.93	0.17	1.04	0.17	6.42	.001

Additional variables such as age, gender, marital status, and place of residence were examined in the project, as were variables associated with stuttering such as age when stuttering began, severity of stuttering, use of stuttering therapy, evaluation of stuttering therapy effectiveness, and intention of using therapy in the future. None of the variables correlated with aspects of temperament.

It was decided to analyse aspects of temperament depending on the severity of stuttering because this was essential to the present study. The results of the intergroup comparisons are presented in Table 4. The one-way ANOVA showed that there are no statistically significant differences between people demonstrating different severity of stuttering symptoms in terms of the strength of the excitation process, strength of the inhibition process, mobility, and balance of the nervous processes.

Table 4

Temperamental Traits of People With Different Severity of Stuttering

Scale	Severity of symptoms						Group comparison	
	Mild		Moderate		Severe			
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p*
Strength of excitation process	47.70	7.82	46,29	8.34	49.35	9.27	1.37	.256
Strength of inhibition process	50.78	5.51	50.85	6.16	51.41	8.59	0.07	.929
Mobility of nerve processes	51.64	8.51	49.38	8.04	52.24	9.90	2.04	.193
Balance of nerve processes	0.94	0.15	0.92	0.17	0.98	0.23	1.32	.269

DISCUSSION

The aim of the research was to distinguish the temperamental factors of chronic stuttering in adults in the light of Pavlov's temperament typology. Based on the conducted analyses, it was showed that the stutterers compared to fluent speakers are characterized by a smaller strength of the excitation process (Pavlov, 1951–1952; 1952).

In Pavlov's theory, the low strength of excitation process corresponds with the high general and emotional reactivity (Strelau & Zawadzki, 1998). Questionnaire studies concerning the temperament of stuttering adults are extremely rare. Guitar (2003) made such an attempt using the Taylor-Johnson Temperament Analysis scale. The group of stuttering adults in these studies achieved more than twice as high results on the scale of emotional reactivity. The results in this scale positively correlated with the level of response to surprise but were not associated with the intensity of speech disfluency symptoms. In addition, higher levels of reactivity in adult stutterers have also been confirmed in studies measuring startle response, understood as an involuntary response to sudden stimuli. An increased startle reaction has been observed in individuals classified as highly reactive. People with an increased startle response were also less likely to suppress the resulting stimuli (Snidman & Kagan, 1994). A higher level of reactivity is an observation commonly repeated in empirical studies on the temperament of stutterers, which in our research co-occurred with a higher strength of the inhibition process and significantly weaker mobility of the nerve processes in the group of stutterers than in the criterion group. In Pavlov's temperament theory (1951–1952) these are characteristic features of the

weak nervous system type. People with this type of nervous system have a small amount of energy, get tired quickly, their reflexes are weak and form slowly. The weak type is also more susceptible to conditioning anxiety reactions and neuroticism and is the basis for shaping features characteristic of introverts (Strelau & Zawadzki, 1998). The strength of the inhibition process means the ability to organize oneself under the influence of interfering stimuli and to control one's behavior and emotions. Results obtained for people who stutter are within the average range and do not statistically differ from the results of the control group. It is difficult to refer this result to those existing in the literature, but some temperament features described in other models are equivalent to the strength of inhibition process. One of these is the behavioral inhibition system, a concept from Gray's (1991) model of temperament. He hypothesized the existence of biological mechanisms for temperamental traits, distinguishing behavior control systems (BIS and BAS) in the brain (Grey, 1991). The anatomical structure is the septohippocampal system, basal ganglia, thalamus nuclei and neocortical area (Wiltink et al., 2006). However, an analysis of the literature on stuttering from the last 20 years has shown that only Alm (2004) tested temperament based on this theory, using the Carver and White Questionnaire (1994). As in our own research, no difference in momentum of the stopping process was found. He also found that stuttering adults do not differ in terms of BIS/BAS from the control group. In turn, in Treleaven's and Coalson's study people who stuttered much slower inhibited inaccurate motor responses, but not verbal responses (Treleaven & Coalson, 2021).

Findings have revealed that preschoolres who stutter have weaknesses in complex response inhibition and stopping impulsivity in the nonverbal domain compared to children with fluent speech (Ofoe & Anderson, 2021).

Another feature of stutterers' temperament that was identified in our own research was significantly lower than in the group of subjects with normal fluency, mobility of nervous processes, which means that adults revealing difficulties in this area are less plastic in behavior, and therefore may have some problems adapting to a new physical and social environment. In children's studies, difficulties in adapting to new situations were widely diagnosed (Anderson et al., 2003; Howell, 2004; Howell et al., 2008). However, there are empirical works from which different conclusions were drawn. In Lewis and Golberg's (1997) study, a group of stuttering children were characterized by a positive approach to new stimuli and high adaptability. Reilly et al. (2009) also obtained similar results. This indicates the need for further research in this area, including a large pool of controlled variables.

What is more, in our own research a significantly lower balance of nerve processes was noted in stutterers than in the criterion group. The observed regularities are in line with the empirical works characterizing the population of people revealing

difficulties with speech fluency as a group with slightly weakened self-regulation processes, as well as quite sensitive and reactive (Anderson et al., 2003; Karrass et al., 2006), which in turn may be associated with a tendency to experience negative affect and an increased susceptibility to frustration (Eggers et al., 2010; Lucey et al., 2019). Based on the assumption that temperament traits—in particular the ability to inhibit certain stimuli in situations where there is a need to create a place for others, adequate to emerging stimuli—allow to predict the severity of stuttering in children and are a potential indicator of clinical prognosis, studies were conducted to verify whether the interventions aimed at improving these processes would reduce the severity of stuttering symptoms and coexisting emotional and behavioral problems. The study involved 28 preschool stuttering children, who were randomly divided into two groups. Children from the first group participated in the therapy of speech disorders, which was combined with activities supporting self-regulation. The second group underwent only a stuttering therapy. Based on the intergroup comparisons, it was found that although the intensity of stuttering was reduced in each group as a result of the activities carried out, the reduction of emotional and behavioral problems, as well as an increase in self-regulation efficiency were observed only in those children whose therapy was supplemented with self-regulation supportive intervention. Consequently, the combination of traditional therapy of speech fluency disorders with the elements enhancing the balance of nervous processes may be an important prognostic indicator for stuttering treatment (Druker et al., 2019), which seems to be particularly important in the context of a small amount of research confirming the relationship between temperament traits and the severity of stuttering and duration of therapy in people of different age groups (Eggers et al., 2010; Kefalianos et al., 2017; Lucey et al., 2019).

Summing up the discussion, it should be emphasized that the conducted research allowed to describe temperamental dimensions in adults with chronic stuttering based on Pavlov's theory (Pavlov, 1951–1952; 1952). These include: lower strength of excitation process, a tendency to a stronger inhibition process, weaker mobility, and lower balance of the nervous processes, which proves the weak type of their nervous system. The obtained data are of great cognitive and practical significance, as they can be used for designing comprehensive and interdisciplinary programs supporting the process of treatment and rehabilitation of adults exhibiting chronic difficulties in speech fluency. The diagnosis model for stuttering should include measurement of temperament traits that are also important for therapy. This approach goes beyond traditional speech therapy, which recommends, among other things, slowing the pace of speech. Our research tells us that this need not be done. Speed of speech is strongly connected to temperament and is modified with great difficulty. A person who stutters is able to slow their speech for a few phrases spoken

with excessive control but then returns to their individual speed of speech. Constant solicitude for controlling a rate of speech inconsistent with temperament exhausts the individual physically and emotionally and makes it difficult to achieve the spontaneous fluency that is the goal of therapy. All too often the withdrawal of adults from therapy may result from a mismatch of methods to individual needs and capabilities.

Limitation

A limitation in the research we conducted was its cross-sectional nature. Although we made a deliberate decision to use a single theory of temperament, we believe that future work could compare research based on varying theories. We believe that future work should also try to relate temperament dimensions to the mechanisms of stuttering.

Conclusions

The analyzes allowed to isolate temperamental factors of chronic stuttering in adults based on the typology of Pavlov. Persons manifesting difficulties with speech fluency compared to the criterion group are characterized by:

– the lower strength of excitation process, which indicates increased reactivity to sensory and emotional stimuli;

– weaker mobility of nerve processes, which makes it difficult to adapt to new situations;

– a lower balance of nervous processes, which indicates a reduced ability to respond flexibly to changing environmental conditions;

– a weaker type of the nervous system (lower strength of excitation process, weaker mobility of the nervous processes), which makes it difficult to cope with the challenges encountered and increases the susceptibility to mental disorders.

CRediT Author Statement

Ewa Humeniuk (70%): conceptualization, methodology, resources, writing (editing).

Zbigniew Tarkowski (30%): conceptualization, writing (review), supervision.

REFERENCES

Alm, P. A. (2004). Stuttering and the basal ganglia circuits: A critical review of possible relations. *Journal of Communication Disorders*, *37*(4), 325–369. https://doi.org/10.1016/j.jcomdis.2004.03.001

Alm, P. A., & Risberg, J. (2007). Stuttering in adults: The acoustic startle response, temperamental traits, and biological factors. *Journal of Communication Disorders*, *40*(1), 1–41. https://doi.org/10.1016/j.jcomdis.2006.04.001

Anderson, J. D., Pellowski, M. W., Conture, E. G., & Kelly, E. M. (2003). Temperamental characteristics of young children who stutter. *Journal of Speech, Language, and Hearing Research*, *46*(5), 1221–1233. https://doi.org/10.1044/1092-4388(2003/095)

Aron, E. N., & Aron, A. (1997). Sensory-processing sensitivity and its relation to introversion and emotionality. *Journal of Personality and Social Psychology*, *73*(2), 345–368. https://doi.org/10.1037/0022-3514.73.2.345

Bodunov, M. V. (1993). Studies on temperament in Russia: After Teplov and Nebylitsyn. *European Journal of Personality*, *7*(5), 299–311. https://doi.org/10.1002/per.2410070503

Caprara, G. V., & Cervone, D. (2000). *Personality: Determinants, dynamics, and potentials*. Cambridge University Press.

Druker, K., Mazzucchelli, T., Hennessey, N., & Beilby, J. (2019). Parent perceptions of an integrated stuttering treatment and behavioral self-regulation program for early developmental stuttering. *Journal of Fluency Disorders*, *62*, Article 105726. https://doi.org/10.1016/j.jfludis.2019.105726

Eggers, K., De Nil, L. F., & Van den Bergh, B. R. (2010). Temperament dimensions in stuttering and typically developing children. *Journal of Fluency Disorders*, *35*(4), 355–372. https://doi.org/10.1016/j.jfludis.2010.10.004

Eggers, K., Millard, S., & Kelman, E. (2021). Temperament and the impact of stuttering in children aged 8–14 years. *Journal of Speech, Language, and Hearing Research*, *64*(2), 417–432. https://doi.org/10.1044/2020_JSLHR-20-00095

Eisenberg, N., Spinrad, T. L., Fabes, R. A., Reiser, M., Cumberland, A., Shepard, S. A., Valiente, C., Losoya, S. H., Guthrie, I. K., & Thompson, M. (2004). The relations of effortful control and impulsivity to children's resiliency and adjustment. *Child Development*, *75*(1), 25–46. https://doi.org/10.1111/j.1467-8624.2004.00652.x

Ellis, J. B., Finan, D. S., & Ramig, P. R. (2008). The influence of stuttering severity on acoustic startle responses. *Journal of Speech, Language, and Hearing Research*, *51*(4), 836–850. https://doi.org/10.1044/1092-4388(2008/061)

Furnham, A., & Davis, S. (2004). Involvement of social factors in stuttering: A review and assessment of current methodology. *Stammering Research*, *1*(2), 112–122.

Grey, J. (1991). The neuropsychology of temperament. In J. Strelau & A. Angleitner (Eds.), *Explorations in temperament: International perspectives on theory and measurement* (pp. 105–128). Plenum Press.

Guitar, B. (2003). Acoustic startle responses and temperament in individuals who stutter. *Journal of Speech, Language, and Hearing Research*, *46*(1), 233–240. https://doi.org/10.1044/1092-4388(2003/018)

Hauner, K. K. Y., Shriberg, L. D., Kwiatkowski, J., & Allen, C. T. (2005). A subtype of speech delay associated with developmental psychosocial involvement. *Journal of Speech, Language, and Hearing Research*, *48*(3), 635–650. https://doi.org/10.1044/1092-4388(2005/044)

Howell, P. (2004). Assessment of some contemporary theories of stuttering that apply to spontaneous speech. *Contemporary Issues in Communication Science and Disorders*, *31*, 122–139.

Howell, P., Davis, S., & Williams, R. (2008). Late childhood stuttering. *Journal of Speech, Language, and Hearing Research*, *51*(3), 669–687. https://doi.org/10.1044/1092-4388(2008/048)

Karrass, J., Walden, T. A., Conture, E. G., Graham, C. G., Arnold, H. S., Hartfield, K. N., & Schwenk, K. A. (2006). Relation of emotional reactivity and regulation to childhood stuttering. *Journal of Communication Disorders*, *39*(6), 402–423. https://doi.org/10.1016/j.jcomdis.2005.12.004

Kefalianos, E., Onslow, M., Ukoumunne, O. C., Block, S., & Reilly, S. (2017). Temperament and early stuttering development: Cross-sectional findings from a community cohort. *Journal of Speech, Language, and Hearing Research*, *60*(4), 772–784. https://doi.org/10.1044/2016_JSLHR-S-15-0196

Kyrios, M., & Prior, M. (1990). Temperament, stress and family factors in behavioural adjustment of 3-5-year-old children. *International Journal of Behavioral Development*, *13*(1), 67–93. https://doi.org/10.1177/016502549001300105

Lewis, K. E., & Golberg, L. L. (1997). Measurements of temperament in the identification of children who stutter. *International Journal of Language & Communication Disorders*, *32*(4), 441–448. https://doi.org/10.3109/13682829709082258

Lucey, J., Evans, D., & Maxfield, N. D. (2019). Temperament in adults who stutter and its association with stuttering frequency and quality-of-life impacts. *Journal of Speech, Language, and Hearing Research*, *62*(8), 2691–2702. https://doi.org/10.1044/2019_JSLHR-S-18-0225

Martin, R. P., Drew, K. D., Gaddis, L. R., & Moseley, M. (1988). Prediction of elementary school achievement from preschool temperament: Three studies. *School Psychology Review*, *17*(1), 125–137. https://doi.org/10.1080/02796015.1988.12085331

Miceli, P. J., Whitman, T. L., Borkowski, J. G., Braungart-Rieker, J., & Mitchell, D. W. (1998). Individual differences in infant information processing. *Infant Behavior and Development*, *21*(1), 119–136. https://doi.org/10.1016/S0163-6383(98)90058-3

Ofoe, L. C., & Anderson, J. D. (2021). Complex nonverbal response inhibition and stopping impulsivity in childhood stuttering. *Journal of Fluency Disorders*, *70*, 105877. https://doi.org/10.1016/j.jfludis.2021.105877

Pavlov, I. P. (1951–1952). Polnoye sobranye sochinienii [Complete works] (2nd ed.). Izdatelstvo Akademii Nauk SSSR.

Pavlov, I. P. (1952). *Dwadzieścia lat badań wyższej czynności nerwowej (zachowania się) zwierząt* [Twenty years of research into the superior nervous function (behavior) of animals] (T. Klimowicz, Trans.). PZWL.

Reilly, S., Onslow, M., Packman, A., Wake, M., Bavin, E. L., Prior, M., Eadie, P., Cini, E., Bolzonello, C., & Ukoumunne, O. C. (2009). Predicting stuttering onset by the age of 3 years: A prospective, community cohort study. *Pediatrics*, *123*(1), 270–277. https://doi.org/10.1542/peds.2007-3219

Riley, G. D. (1972). A stuttering severity instrument for children and adults. *Journal of Speech and Hearing Disorders*, *37*(3), 314–322. https://doi.org/10.1044/jshd.3703.314

Riley, G. D., & Ingham, J. C. (2000). Acoustic duration changes associated with two types of treatment for children who stutter. *Journal of Speech, Language, and Hearing Research*, *43*(4), 965–978. https://doi.org/10.1044/jslhr.4304.965

Rothbart, M. K., Ahadi, S. A., Hershey, K. L., & Fisher, P. (2001). Investigations of temperament at three to seven years: The Children's Behavior Questionnaire. *Child Development*, *72*(5), 1394–1408. https://doi.org/10.1111/1467-8624.00355

Snidman, N., & Kagan, J. (1994). The contribution of infant temperamental differences to acoustic startle response. *Psychophysiology*, *31*(1, Suppl.), S92.

Strelau, J. (1997). The contribution of Pavlov's typology of CNS properties to personality research. *European Psychologist*, *2*(2), 125–138. https://doi.org/10.1027/1016-9040.2.2.125

Strelau, J. (2001). *Psychologia temperamentu* [The psychology of temperament]. PWN.

Strelau, J. (2006). *Temperament jako regulator zachowania: Z perspektywy półwiecza badań* [Temperament as a regulator of behavior: From the perspective of half a century of research]. Gdańskie Wydawnictwo Psychologiczne.

Strelau, J., & Zawadzki, B. (1998). *Kwestionariusz temperamentu PTS* [PTS Temperament Questionnaire]. PTP.

Tarkowski, Z. (2018). *A systems approach to the psychosomatics of stuttering*. Nova Biomedical.

Teplov, B. M., & Nebylitzyn, V. D. (1966). The study of the basic properties of the nervous system and their significance for the psychology of individual differences. *Soviet Psychology and Psychiatry*, *4*(3–4), 80–85. https://doi.org/10.2753/RPO1061-040504030480

Tichenor, S., & Yaruss, J. S. (2020). Repetitive negative thinking, temperament, and adverse impact in adults who stutter. *American Journal of Speech-Language Pathology*, *29*(1), 201–215. https://doi.org/10.1044/2019_AJSLP-19-00077

Treleaven, S. B., & Coalson, G. A. (2020). Manual response inhibition and quality of life in adults who stutter. *Journal of Communication Disorders*, *88*, 106053. https://doi.org/10.1016/j.jcomdis.2020.106053

Treleaven, S. B., & Coalson, G. A. (2021). Verbal response inhibition in adults who stutter. *Journal of Speech, Language, and Hearing Research*, *64*(9), 3382–3397. https://doi.org/10.1044/2021_JSLHR-20-00739

Wiltink, J., Vogelsang, U., & Beutel, M. E. (2006). Temperament and personality: The German version of the Adult Temperament Questionnaire (ATQ). *GMS Psycho-Social Medicine*, *3*, Article 10.

Zebrowski, P. M., & Conture, E. G. (1989). Judgments of disfluency by mothers of stuttering and normally fluent children. *Journal of Speech, Language, and Hearing Research*, *32*(3), 625–634. https://doi.org/10.1044/jshr.3203.625