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**MEDICAL STUDENTS' SELF-REFLECTION OF STRESS
MANAGEMENT: A PSYCHOLINGUISTIC ANALYSIS**

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Abstract

Studying medicine makes significant demands both cognitively, emotionally and personally. In the subject Stress and stress management, students get to know the concept of stress, its manifestations and various stress management techniques, some of which are practiced practically. This subject ends with a seminar paper in which students consider how they manage stress. This study offers an analysis of these essays based on the following research questions: What semantic and morpho-syntactic categories do students use in considering their approaches to stress management? How does coping reflection (in terms of semantic and morphosyntactic categories) differ between male and female students? The research sample comprised 145 students, of which 48 were males and 97 were females. The research used a quantitative text analysis method where semantic categories were detected automatically using the LIWC program and using word embedding analysis in Python. The JASP program, descriptive analyzes and t-tests were used for statistical analyses. Results showed that women wrote statistically significantly longer texts (on average 13 sentences, 243 words longer) and used fewer function words, especially first-person singular pronouns, more negation words related to drives (contradiction and hesitant words), affect (negative tone, negative emotions, sadness), social (family) and lifestyle (work) words in their essays compared to male students. The study findings offer opportunities to delve deeper into psycholinguistic aspects of this area.

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1. Introduction

In recent years, the issue of psychosomatic medicine has come to the fore, and this is no different in the education of medical students. The education of future doctors concerning stress is important not only for their own well-being, taking into account their individual personalities, but also for professionals who, in retrospect, have a relatively large influence on their patients and can shape their lives. The psychological aspect affects our entire life, and it can be said to impact our health.

Medical students themselves undergo tremendous stress right from the beginning of their studies. As psychologists working with the psyche of medical students, we understand the gravity of this issue very well. The extensive syllabus they must master within the given terms, along with regular tests in anatomy and biology right after entering medical faculty, often lead to immense self-doubt for many students. The daily workload and long hours of study further contribute to serious self-doubt. To address these challenges early on, first-year students have a subject specifically designed to help them manage the stress arising from the demanding nature of their studies. In this subject, they receive education and guidance on recognizing stress, learning effective tension management techniques, understanding their own personality type, and exploring various options for handling stress and their potential effects. The subject also includes a study style test that helps them identify their preferred learning approach. For example, they learn whether they apply the so-called elaborative view of the material, wherein they can find connections and put the subject matter into their own words, or if they lean towards mechanical learning, relying on factual memorization of data as their basis for effective studying. Additionally, they explore the possible links between mastering the subject matter and experiencing stress.

2. Problem Statement

Studying medicine is very demanding, placing significant cognitive demands (such as a heavy load on memory and learning) and emotional and personal challenges on students, particularly in stress management. In the Basics of Self-Knowledge and Stress Management course, students are introduced to the concept of stress, its manifestations, and various coping techniques. The subject also offers a self-reflective exploration of one's attitudes and values, allowing students to try some practical strategies. The course concludes with a seminar paper, requiring students to reflect on how they manage stress and perceive themselves. In this study, we aim to see how the written expression relates to coping with stress and the personality of the physicians.

2.1. Personality of a medical student

According to Smékal (2009), the field of personality psychology currently encompasses nearly 200 models, concepts, or theories of personality, each of which is being studied by various disciplines such as philosophy, sociology, and theology. These theories offer distinct perspectives on the nature of personality. In general, most definitions agree that "personality represents the totality, connection or combination of a person's character, temperament, abilities and also constitutional qualities" (as cited by Cakirpaloglu, 2012 p. 16).

Medical students are educated to fulfill a "task", to fulfill a goal. Čakrt (2017), who in his research, among other things, dealt with personality typology in medicine, based on Jung's vision of personality, found that according to statistics in the medical profession, the most common sensory style was a predominance of thinking, sometimes also called systematic because medical professionals typically like order, control and certainty as they deal with specific, measurable and precisely determined data. According to Čakrt (2017), these types are often found in emergency services, emergency rooms, ARO or trauma centers, as they have to quickly assess the situation and begin to solve it pragmatically without further ado. A lesser number of medical professionals tend to have a sensory style with a predominance of feeling. This group's strength lies in negotiation and persuasion, for although they also rely on concrete data and facts, but unlike other types, they incorporate their own and others' opinions, preferences, and values in their evaluations, rather than strictly adhering to objective and logical rules. These professionals like to be in contact with the patient "as a person", and as such, more often, they become general practitioners or specialists like pediatricians with their own private practice.

It is important for our study that personality is also reflected in the way an individual deals with language. Psycholinguistics and sociolinguistics are fields on the rise. For example, they deal with the relationship between language preferences and personality. In relation to the MBTI and the BigFive, they were investigated for example by Mehta et al. (2020), who found, among other things, that openness was best predicted by the count of unique words, the number of 1st person singulars and the number of words referring to cognitive processes (e.g., cause, know, ought) and number of apostrophes. Predictions for the conscientiousness dimension, very important for doctors, were most influenced by the number of self-references in an essay, the number of causation words (e.g., because, effect), and the fraction of unique words in all words of an essay and so on. Many other studies (Newman et al., 2003; Cohn et al., 2004, Monzani et al., 2021; Pennebaker et al., 2014) confirm and refine the relationship between personality traits and also between less permanent characteristics such as stress.

2.2. Stress and coping strategies

Stress was first described in his work in 1949 by Hans Bruno Selye. It is a feeling of physical, mental or social integrity that threatens health. Overall, it is an excessive load, in which so-called eustresses and distresses play a role. Eustress is short-term, so-called "good" stress while distress means negative long-term stress, which can also cause health complications. Selye understands stress as a state in which the organism does not emphasize stimuli or individual differences. Křivohlavý (2001) states that stress occurs when individuals are put under stress or under pressure from all sides. Smolík (2002) narrows down the definition of stress to indicate various objects of resistance or significantly unpleasant situations for individuals.

Many studies show that female students are more stressed than male students (Böke et al., 2019, Eisenbarth, 2019, Sue Graves et al, 2021). We will not deal with interpretations of causes and connections now; we only state that this is a common fact and we assume that the same situation prevails in our research group. We will therefore focus our analyses on the assessment of gender differences.

Individuals choose different strategies for coping with stress. Basic forms of stress management according to Müller De Morais, and Škorvagová (2021) include the strategy of inaction or apathy;

avoidance strategy; strategy of attacking the attacker; and strengthening one's own sources of strength. For medical professionals, factors that can slow down the so-called stress, such as indomitability, optimism and positive self-evaluation, play an important role. Other means for managing stress are relaxation, meditation, and imagination. Social support is an important factor in managing stress. The possibility of having someone to talk to and the possibility of having a close person who understands the burden is a support for the student. Another important stress management strategy is preventing loss of enthusiasm. Burnout syndrome occurs when a person loses joy in what he is doing and does not see the meaning in the given situation. The prevention of burnout syndrome and loss of joy is to engage in activities that give joy and meaning which is a highly appealing strategy among medical professionals. Even a first-year student should not neglect what they like. Despite studying, they should participate in physical activities like jogging, play a musical instrument, in short, anything that makes them happy. Physical activity is a huge help in managing stress. Exercise, physical movement leads to the removal of toxins that act as stressors. Finally, one of the strategies that help to manage stress is faith and meaningfulness. Belief and meaningfulness refer to the state of mind where when one believes that what one is doing makes sense, it leads to positive repercussions.

All these topics and information about stress and its management are taught within the subject mentioned and therefore, becomes the subject of reflection in the analysed essays in the monitored semantic categories.

3. Purpose of the Study

The purpose of the study is to identify which semantic categories students use when they reflect on how they approach stress management. If some topics are missing in the reflection, it is possible that the students have not learned enough and it may be difficult for them to cope in the future. The basic question driving this study is: How do essays reflecting on stress and coping differ (in terms of semantic categories and morphosyntactic text characteristics) between male and female medical students? This basic question has been subdivided into several components as seen in the section on Research Questions.

The secondary aim of the study is to find out whether the chosen text analysis methods are suitable for essay analysis, as we would like to continue using them for other research questions and more sophisticated research goals (such as predicting success in the studio or mental health).

4. Research Questions

The research questions are as follows:

- i. What semantic categories do students use when they reflect on how they approach stress management?
- ii. What morpho-syntactic categories do students use when they reflect on how they approach stress management?
- iii. How does coping reflection (in terms of both semantic and morphosyntactic categories) differ between male and female students?

5. Research Methods

5.1. Research strategies, data collection techniques, research samples

Medical students at the researchers' university have to participate in the seminar "Stress and its management" as part of their study program. The educational goals of the seminar are to teach students the mechanism of stress, to recognize signs of stress in themselves and others, to distinguish between different types of stress, to know about the consequences of stress (especially long-term negative stress), to identify one's own stressors, to know different stress management strategies, to try some coping techniques to prevent stress. The seminar ends with an essay in which the students have an unstructured assignment "Write an essay on the topic of Who I am and how I manage stress." The assignment is deliberately very free as the teacher implicitly expects that in the essays the students will focus on self-reflection in relation to the study of medicine. It is indicated that they may focus on the stressors associated with their studies and use the knowledge of the seminar (especially focused on stress management).

Essays were submitted in electronic form via e-mail directly to the subject teacher. The essay was submitted by all students of the course: a total of $N=145$ students, of which N men =48 and N women =97. The research was conducted using a quantitative approach by using a quantitative method of textual analysis. Semantic categories were detected automatically. The list of categories was based on the Linguistic Inquiry and Word Count (LIWC): software for analyzing word use (Boyd et al, 2022). Since the program also provides morphosyntactic analysis, we extracted this automatic function ad hoc and attached a sub-research question, which morphosyntactic categories appear in the texts, or men and women differ in them. Although this question is not directly related to the main goals of the study, the findings can serve as a springboard for further psycholinguistic research. The program automatically provides output variables for each text that are shown as percentages of total words within a text (with the exception of the category WC = word count and number of sentences).

Furthermore, we used a new and unique method of word embedding to identify semantic categories. Word embedding is a method of numerical representation of words (sentences, paragraphs) used in computer processing of natural language. It consists in converting words (sentences, paragraphs) into vectors so that units with similar semantic properties are located close to each other. The resulting vector (number) expresses the semantic proximity to the entered term. In our study, we followed the agreement with the expected topics that were addressed within the teaching in the Stress seminary, namely: family-love-friendship, change-cause, time-period, course of time, movement, space, society-state-group, quantity-number, stress, depression, anxiety, coping, self-reflection and self-confidence. A procedure was programmed in Python for vector calculation (Balaha & Saafan, 2021) using a Czech contextualized language representation model RobeCzech developed by Straka et al. (2021). The higher the value of the number of that vector, the more the text of the student's paper is about the subject under investigation.

The resulting LIWC categories and vector values for individual semantic categories were inserted into a .csv file and statistically processed in the JASP version 0.17.1 program.

6. Results

The linguistic analysis of the quantitative data was carried out and the texts were compared in terms of their length (sentences), the number of words (words) and the number of so-called grammatical words (also referred to as synsemantics, i.e. words that need noun-type autosemantics to understand their meaning or verb; these are usually conjunctions, prepositions and other parts of speech that do not carry meaning by themselves). The results of the Mann-Whitney t-test showed that *men wrote statistically significantly shorter texts* that had a smaller number of sentences (mean_{men}=59, mean_{women}=72, W=1386.5, p<.001); a smaller number of words (mean_{men}=1104, mean_{women}=1347, W=1364.0, p<.001); and a smaller number of grammatical words (mean_{men}=10, mean_{women}=14, W=1376.5, p<.001). *On average, women wrote texts that were 13 sentences longer, 243 words (the number of grammatical words is naturally a similar proportion greater)*. Effect size was given by the rank biserial correlation, the value of which varied within a narrow range <-0.404 - -0.414> (see Table 1).

Table 1. Gender differences in basic quantitative indicators of the text: Mann-Whitney test (N_{men}=48, N_{women}=97)

Items	W	Mr	r-bc	mean names	mean women	SD names	SD women
WC	1467.0	< .001	-0.370	1136.125	1353.402	463.735	382.183
sentences	1386.5	< .001	-0.404	58,583	71,938	36,436	25.146
BigWords	3172.0	< .001	0.363	18.330	16.804	2.301	2,095

Since there was a statistically significant difference in morphosyntax as a whole (the Linguistic variable is the superior category for all analyzed morpho-syntactic indicators of the text), we took a closer look at the differences in individual morphosyntactic elements. Table 2 shows all variables where a statistically significant difference was found. It needs to be noted here that it is not about frequency, but about the ratio of indicators. The results show that female students use fewer function words in their essays, namely more pronouns in the first-person singular (so-called I words) and fewer pronouns in the third person plural. Furthermore, male students use determiners (indicative pronouns) and numbers more often. In terms of interpretation, probably the most interesting finding is the fact that women use significantly more negation (words with a negative prefix and words that negate the meaning) in their essays.

Table 2. Gender differences in morpho-syntactic indicators of the text: Mann-Whitney test (N_{men}=48, N_{women}=97)

Independent Samples T-Test	Examples	W	Mr	r-bc	mean names	mean women
Linguistics		1451.0	< .001	-0.377	75,920	77,764
Function words	the, that, and, I	1661.5	0.005	-0.286	62.903	64.108
Total pronouns	I, you, that, it	1398.5	< .001	-0.399	11,479	12,846
1st person singular	I, me, we, myself	1784.5	0.023	-0.233	8,780	9,820
3rd person plural	they, their, themsel*	1789.0	0.024	-0.232	0.503	0.658
Determiners	the, at, that, we	3055.5	0.002	0.313	15.531	14,751
Numbers	one, two, first, once	2967.5	0.007	0.275	1.141	0.927
Negations	not, well, believe, nothing	1573.0	0.002	-0.324	1,816	2.151

An essential element of the analysis was the semantic categories of the texts. This section discusses the results obtained from SW LIWC (dictionary based). Table 3 shows all superordinate categories (always starting with a capital letter) and specific results for statistically significant differences. It is to be noted here that the mean values in the table display the average percentage representation of expressions of the given category in the assessed essays of medical students. The results show that female students used more categories Drives (discrepancy and tentative words), Affect (negative tone, negative emotions, sadness), Social (family), Lifestyle (work), Physical (food, allure) in their essays. The statistical difference was NOT manifested in the Culture and Perception categories.

Table 3. Gender differences in dictionary-based semantic indicators of the text: Mann-Whitney test (Nmen=48, Nwomen=97)

Items	Examples	W	Mr	r-bc	mean names	mean women
DRIVES		2222.5	0.659	-0.045	5.059	5.083
discrepancies	would, can, want, could	1835.5	0.039	-0.212	2.123	2.326
tentative	if, or, any, something	1848.5	0.044	-0.206	2.603	2.957
AFFECT		2015.0	0.189	-0.134	5.821	6.118
Positive tone	good, well, new, love	2333.5	0.983	0.002	3.555	3.562
Negative tones	bad, wrong, too much, hate	1832.0	0.037	-0.213	2.129	2.431
emotion	love, hate, sad	1750.5	0.015	-0.248	2.481	2.867
positive em	good, love, happy, hope	1904.5	0.075	-0.182	0.990	1.114
negative em	bad, hate, hurt, tired	1804.5	0.028	-0.225	1,350	1,624
Anxiety	worry, fear, afraid, nervous	1994.5	0.162	-0.143	0.951	1.127
Anger	hate, mad, angry, frustrate*	2131.0	0.378	-0.085	0.065	0.079
Orchard	:(, sad, disappoint*, cry	1510.5	< . 001	-0.351	0.070	0.147
SOCIAL		2146.0	0.446	-0.078	7,995	8.215
Family	parent*, mother*, father*, baby	1859.0	0.048	-0.201	0.330	0.382
CULTURE		2510.5	0.437	0.078	0.153	0.131
LIFESTYLE		2830.0	0.035	0.216	4.308	3,673
Home	ome, house, room, bed	1727.0	0.010	-0.258	0.112	0.180
Work	work, school, working, class	2754.5	0.073	0.183	2,860	2.438
PHYSICAL		2187.0	0.555	-0.061	1,680	1,780
Food	food*, drink*, eat, dinner*	1728.0	0.011	-0.258	0.144	0.238
Allure	have, like, out, know	1628.5	0.003	-0.300	6,598	7.175
PERCEPTION		2135.5	0.420	-0.083	7.574	7,784

Semantic categories of texts, categories created via embedding from the RobeCzech model were also analysed.

Table 4. Gender differences in embodied-based semantic indicators of the text: Mann-Whitney test (Nmen=48, Nwomen=97)

Embedding categories	W	Mr	r-bc	mean names	mean women
quantity, number	1657.0	0.004	-0.288	0.146	0.299
Stress	3004.000	0.005	0.290	0.825	0.814

Table 4 shows the categories where statistically significant differences between groups were found. The results show that there were no differences in the categories: family-love-friendship, change-cause, time-period, passage of time, movement, space, society-state-group, depression, anxiety, coping, self-reflection and self-confidence. Statistically significant differences were identified for two variables: *quantity-number* (women use it more often) and *stress* (men use this semantic category more often in the essay).

7. Discussion

The study focuses on the analysis of essays written by medical students as part of a subject focused on the topic of Stress and its management. To analyze the essays, we used sophisticated semi-automated analytical tools: LIWC software and embedding analysis in the RobeCzech environment in Python.

The findings reveal that men produce shorter texts, while women wrote essays that were on average 13 sentences (243 words) longer than men. This is not a surprising result. It is widely known that the female brain develops differently, and there is repeated evidence that girls speak earlier and more often from toddler age (see e.g., Eriksson et al., 2012).

The results show that female students use fewer function words in their essays, namely more pronouns in the first-person singular (so-called I words) and fewer pronouns in the third person plural. What does this result mean? McDonald et al. (2012) found that fewer function words are a typical feature of text anonymization. Perhaps the female students did not want to reveal their innermost self through the essay; preferring to submit an impersonal essay which was just a completed assignment with no deep self-questioning. Pennebaker (2011) also found that a person who uses fewer I-words is higher in the social hierarchy which may be postulated as female medical students feeling more important than male students. However, this is merely a supposition. A bolder and rather contentious interpretation may be offered. Nida (1982) found that people suffering from headaches used fewer function words. A very daring interpretation that would flow from the connection of our result with Nida's findings is that the female students were more likely to suffer from headaches when writing essays. Although this sounds like a wild juxtaposition of findings, it is not impossible as for example, Al-Hassany et al. (2020) demonstrated in their epidemiological study that women suffer from headaches more often. At the very least, it may trigger further research.

In the analysed essays, male students use determiners (indicative pronouns) and numbers more often. This is consistent with the findings of other authors. For example, Herring and Paolillo (2006) show that vice determinants reliably predict male blog writers. In language development, the beginning of the use of determiners is associated with the development of abstract thinking (Valian et al., 2009). A perhaps

somewhat presumptuous interpretation is offered that men are more abstract when writing essays about their personal stress and its management, while women are more specific, respectively that men tend to generalize while women give more specific examples. It can be a topic for further investigation.

The results of the semantic analysis show that female students used more categories drives (discrepancy and tentative words), affects (negative emotions and others), social (family), lifestyle (work), physical (food, allure) in their essays. No statistical difference was noted in the categories of culture and perception. This means that the female students in their essays touched on topics related to the basic setting, social, family and lifestyle contexts of experiencing stress and managing it in a greater proportion than men. They also included more physical aspects – dealing with food and allure. This is quite consistent with the findings of other studies showing that attitudes toward food are related to self-control and dietary healthiness (Fan & Wang, 2022; Keller et al., 2016; Sproesser et al., 2011). Healthy behavior is also typical among female students (Dosedlová et al., 2013).

An interesting finding is that female students used significantly more negation (words with a negative prefix and words that negate the meaning) in their essays. Negatives are used by speakers when denying the validity content, when they forbid realization of the sentence content, or do not want to wish its realization at all. Havigerová et al. (2014) state that negative statements are indicators of negatively oriented emotions experience, emotions attention, and thinking, as it focuses attention towards negative phenomenon, negative emotions, negative interpretations, and memorising which refers to the reduced extent of memory storing with the connection to negative emotion. The study's data show a link with negative affect, as the results of the semantic analysis show that female students used more negative tone, negative emotions, and sadness categories in their essays. At the same time, there is a lot of morphosyntactic phenomenon of negation in the essays. It can be deduced that there will be a correlation between the morphosyntactic sign of negation, the semantic element negative tone and the phenomena mentioned above (negative experience, poorer memorization, etc.) and that this will be more frequent among female students. It is potentially a subject for further research.

Last but not least, men used the semantic category stress more often in their essays. We can only speculate that they simply stuck to the assignment more strictly and thematically focused on the given topic without unnecessary digressions. It is theoretically possible that they actually experienced more stress, but we have no relevant data from the students to support this claim. To extend this study, we plan to give the students a stress load questionnaire and a coping strategies questionnaire at the same time as the essay, so that we can support these assumptions with empirical evidence which would deepen the connections between teaching, psychology, and the text.

8. Conclusion

This study focused on the gender differences in the textual analysis of essays written by medical students on the topic of stress and its management. The essays were analysed using a special program which isolated categories based on morphosyntactic and semantic markers to identify levels of stress and coping mechanisms used by female and male students. The analysis highlighted a number of differences that require further in-depth analysis and research. The study also showed that LIWC and embedding analyses methodology have an unexploited potential for analyses of student teacher texts. We believe that further

research in this area will be a valuable original stimulus for improving student preparation for the challenges of both student and professional medical life.

Data Availability Statement

Data is available upon request.

Declaration of Conflicts Interests

The authors declare that they have no conflict of interest to disclose.

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