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## Effect of First Meetings on Pulse Changes in Relation to Gender, Personality and Communication Type

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### **Abstract:**

*Communication during first meetings such as job interviews, conference talks and conference networking is crucial for building relationships. Communication disturbances may be critical for professional and private successes as well as fruitful cooperation in future life. One such factor which may cause decrease in quality of communication is stress. Physiological and psychological bases of stress are well known, however it hasn't been well investigated particularly in relation to first meetings. In this study we tested communication quality and stress responses of tested students revealed through the pulse measurements during the simulated first meeting. Since behaviour is the overall output of the function of nervous system, we classified our results according to gender and personality types of tested subjects. Our study reveals new insight into the nature of stress responses for the communication process, what may be used to improve the quality of professional meetings and conferences.*

**Keywords:** Meetings quality, stress responses, heart rate changes

### **1. Introduction**

Interpersonal communication is crucial for healthy psychological life in society. Exchanging ideas and feeling needed is the motivational power of human existence. Rapid technological progress changes the nature of communication channels shifting them from direct contact between people towards virtual connections in cyberspace. Easy and rapid access to information using internet connection reduces memory skills. Intensive development and broad access to social media cause reality overlapping with digital worlds. The language we use and levels of comprehension change. In effect, the ability to communicate in direct contact decreases. Lack of training in communication with people isolates from environment, without relief coming out from the interpersonal feedback. Lack of training in communication induces increased levels of stress, what might be at the end a source of communication failure. Particularly first meetings can be stressful because, like any new experience, they are venturing people into unknown. Feeling stressed and anxious before meeting can become a real block and stops people from being able to relax and allow their personality to shine through. There are several physiological symptoms of stress, which can be evoked during first meetings. Hormones, especially cortisol and adrenalin start pumping after activation of the hypothalamic-pituitary-adrenal axis (O'Connor et al., 2000). In effect, heart rate goes up, blood vessels dilate, breathing and sweat production increases, muscles become tense, pupils enlarge, metabolism, immune system and sex hormone production slows down. All these symptoms have been well investigated however still it is unknown how people react to professional meetings such conferences, and if there is any relation between stress levels and character of asked questions during professional meetings or relation between stress levels and personality type.

Heart rate variability (HRV) is recognized as a versatile and promising non-invasive marker of autonomic nervous system modulation (Weippert et al. 2010; Sookan 2012). Research into the use of HRV has increased in both clinical and research environments and over a broad spectrum of disciplines (Nunan et al. 2009; Pinna et al., 2007). Under normal resting conditions in healthy individuals, it has been suggested that the parasympathetic pathway is dominant, resulting in a high HRV, (Algra et al., 1993), while lower HRV and poor health has been linked to increased sympathetic activity at rest (Umetani et al, 1998; Lopez et al, 2006). Age, physical activity status, gender and the HRV parameter are important factors to consider when examining HRV (Umetani et al., 1998; Ryan et al., 1994; Ramaekers et al., 1998, Sinnreich et al., 1998). High frequency heart rate spectral power (associated with parasympathetic activity) and the overall complexity of heart rate dynamics are higher in women than men. These complementary findings indicate the need to account for genders as well as age-related differences in heart rate dynamics. Whether these gender differences are related to lower cardiovascular disease risk and greater longevity in women requires further study (Ryan et al., 1994). In this study we based our measurements on simplified HRV analysis by monitoring only heart rate and not blood pressure. We decided to reduce measurements because of two reasons. First, we wanted to introduce minimal stress factors coming from measuring devices and therefore sustain

meeting conditions as natural as possible. Secondly, to clarify the interpretation of data, because it is speculated that heart rate-derived variables reflect a central pathway in cardiovascular control mechanisms, while the blood pressure response is more influenced by local conditions in the working muscles that partly mask the effect of changes in mental workloads (Hjortskov et al., 2004).

In addition to physiological stress symptoms, cognitive, emotional and behavioural signs may occur. Since physiological and cognitive stress responses occur immediately in response to stressful situation, we focused on these two types of stress signs. Cognitive deficits caused by stress affect one or all of the following areas: attention (including visuospatial neglect), memory, problem solving, reasoning, organizing, planning, and awareness of deficits. These deficits impact communication by decreasing the efficiency and effectiveness of comprehension, expression and pragmatics (a person's use and interpretation of verbal and nonverbal language in social interaction). Specific language deficits often affect non-literal language, alternative meanings, and other subtleties of language. Conversation may focus on insignificant details and speech may be rambling (Cicerone et al., 2000).

Stress effects on the communication quality are known, however there are no studies showing how stress responses are changing at the time of meeting duration, and if this depends on gender, communication or personality type.

## 2. Materials and Methods

84 subjects (age 18-30 years), participated voluntarily in the experiment. We selected students from two occupational areas: business and scientific. Business students from the Vistula University and students of informatics and physics from the University of Science and Technology and Jagiellonian University respectively. Individuals were divided randomly into two groups for two different types of interviews: in direct and written communication types. Answering process during the simulated meeting was video-recorded and pulse of tested volunteers was measured using non-invasive method via pulsoximeter (Contec™, Contec Medical Systems CMS60C) - a tool commonly used in hospitals to monitor patients after surgeries. After the interview subjects were asked to get feedback about the quality of the communication during the meeting and afterwards filled the Jung personality test (Scheme 1). Before the experiment, students were informed about the plan of testing procedure. Each volunteer subscribed the agreement for analysis and publishing data for the purpose of this project.

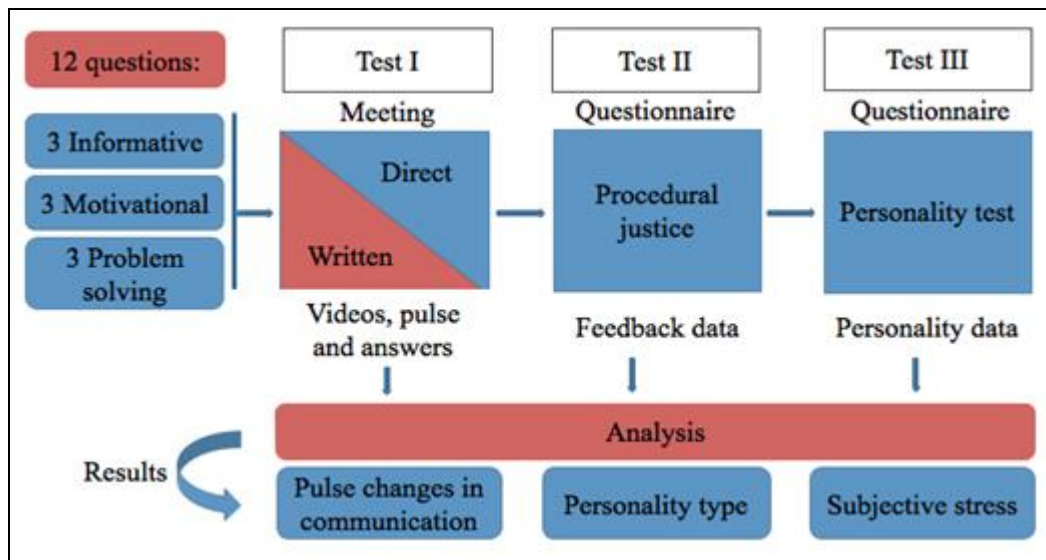


Figure 1

Scheme 1. The experiment design and testing procedures to measure pulse changes, stress levels and personality type in direct and written communication types during simulated first meeting. During Test I we simulated personal interaction, in which either in direct or in writing form, subjects were asked to answer 3 types of questions. After the interview with pulse- and video-recordings students were asked to fill two questionnaires in order to get feedback and personality data.

### 2.1. A Simulation of the First Meeting

The first part of the project was a simulation of the meeting in direct or written communication types depending on selected group. An interviewer didn't have any contact with students before the experiment, so it was a simulation of the meeting, where people meet first time. During the interview 12 questions were asked or were written down.

Informational	Motivational	Problem solving	Emotional
What is your job now?	Your actual professional goal?	What are you doing to reach this goal?	Which projects, which you have already realized made you the most happy and why?
What is your last read book?	Do you realize some optional projects for pleasure?	Do you prefer to work in hierarchic or equal structure?	What are you doing in your free time?
Are you a member of some associations, sport groups, professional groups, etc?	What are your professional successes?	Do you prefer team or individual work?	Do you have any passion/hobby?

Table 1

Table 1. The design of questions for the interview. Informational questions were supposed to activate memory, motivational questions were asked to induce logic thinking, problem solving questions were asked to activate decision centres. Finally, emotional questions were asked to enhance emotions.

Questions were designed to activate memory, logic thinking, decision centres and emotions of tested person. 3 questions were informational, 3 motivational, 3 problem solving and 3 emotional respectively to listed above four types of brain activations (Table 1). Questions were asked or written in fixed mixed order (see Supplementary Materials). In case of direct communication, tested person was video- and pulse-recorded, sitting in front of the meeting leader and answering the questions. In written communication, a person was video- and pulse-recorded, asked by meeting leader to sit and write the answers on the paper.

## 2.2. Pulse Recordings

Just before the interview a pulsoximeter was attached either to the right forefinger in case of direct interviews, and the right or left forefinger depending if a person was right- or left-handed in written type of communication. Initial and terminal pulse value in bpm's (beats per minute), the pulse amplitude and frequency of pulse' changes were read from live-time plots created automatically in software provided by ContecMedical Systems.

## 2.3. Questionnaire – A Situational Judgment Test

Next task for students was to make a subjective judgment concerning the quality of given answers, level of engagement, comprehension and stress induced by asked questions. The quality of answers was measured in scaled values from 0 to 6, but verbal description was also allowed. 0 depicted the lowest quality, while 6 was maximum.

## 2.4. Jung Test

Personality types were characterized using commercially available human metrics Jung Typology Test™ (<http://www.humanmetrics.com/cgi-win/jtypes2.asp>), based on Carl Jung and Isabel Briggs Myers typological approach to personality, and translated in polish if needed. The test consisted of 72 questions. Each test was scored online by a human metrics software to obtain 4-letter type formulas: introversion (I) versus extraversion (E), intuition (N) versus sensing (S), thinking versus feeling and judging (J) versus perceiving (P).

## 3. Results

### 3.1. Heart Rate's Changes Might Reflect Variability in Stress Responses

The interview time in both types of communication took from 4 to 8 minutes depending on individual changes in answering the questions. To define increase or decrease of pulse we compared starting and terminal bpm values (Table 2). Additionally we analyzed types of pulse spectrum by looking at the shape of generated by pulsoximeter curve during recordings. We observed five main types of heart beat changes which might reflect different physiological processes including stress responses in tested individuals: increase, decrease, hill, depression and plateau (no changes values of bpm's during the interview). We were also able to observe differences in frequency and amplitude of pulse changes. In most cases we observed either increase, or decrease of the heart rate. Some individuals reacted with increase of heart rate at the end of the interview, what suggests slow response to the stressful situation (Fig.2A). Other students reacted fast, with a high pulse in the beginning of the interview and calmed down already at the end of the experiment (Fig.2B). Less frequent observations revealed pulse changes resembling a hill, a depression and plateau curves (Fig.2C-F).

	Women [bpm]		Men [bpm]	
	Direct	Written	Direct	Written
Pulse decrease	4	6	10	6
Pulse increase	8	11	5	2

Table 2: Number of students with pulse changes in two different communication types

### 3.2. Heart Rate's Changes in Different Communication Types

Among 22 analyzed students participating in written communication, 50% showed increased and 50% decreased levels of heart beats. Among them 9, 1% revealed hill-shaped changes in bpm values, 9% depression and 18% plateau. In direct communication a small predominance of increased levels of pulse in relation to overall tested group was observed. In case of 26 tested students for direct communication, 54% had increased and 46% decreased heart rates. Only 7, 7% of students had detected hill-shaped curve, but interestingly 15% of tested subjects revealed depression, and in this case no plateau curve was seen. We also noticed differences in heart rate amplitude (jumps in levels of heart beats). In face to face meetings the amplitude was slightly larger comparing to written interview. The average decrease value of the amplitude was 8, 5 beats per minute and average increase 10, 4 bpm for the verbal communication, and for written averages were: decrease 6, 9 bpm, and increase 10 bpm. The maximal amplitude was slightly larger in case of direct communication (average 11, 86 bpm, 56%), and in writing was averaged at 9,4 bpm (44%). Frequency in direct speaking was high in 12 cases, and low in 14 cases. In writing the frequency was high in 10 cases, and low in 12 cases.

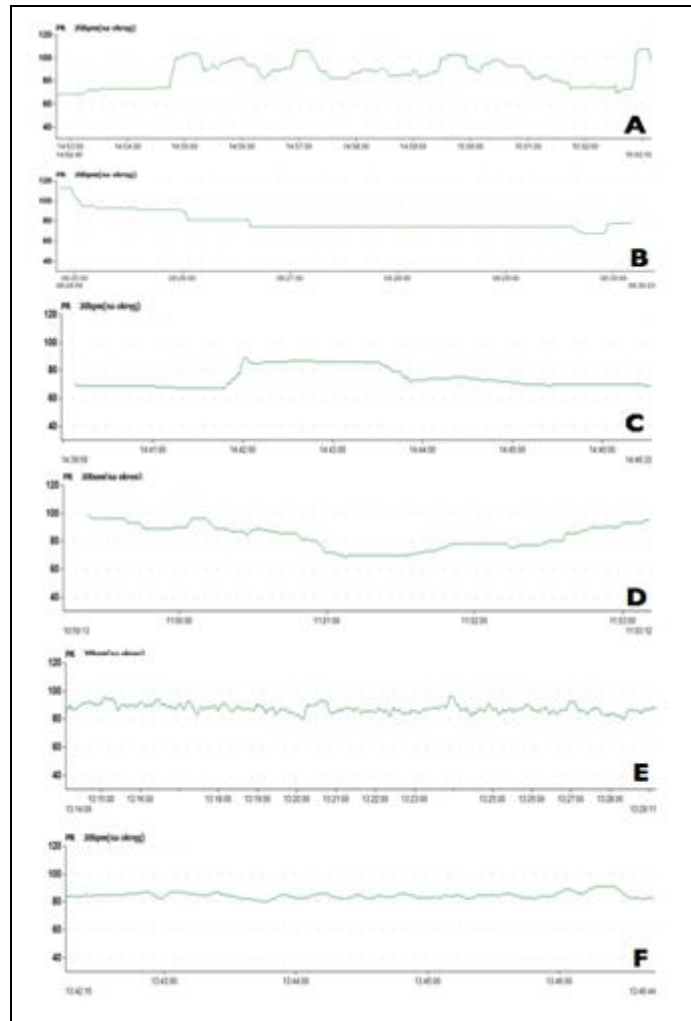


Figure 2

Figure 2. Four main types of stress responses in analyzed people. Plots from pulsoximeter show heart beat levels (vertical axis: bpm) in relation to time (horizontal axis: minutes), which are either increased at the end of the interview (A), or decreased in time (B), a hill-shaped curve (C), or a depression curve (D). In only few cases plateau curves were detected: an example of high amplitude and high frequency (E), and second case with very low frequency and amplitude (F).

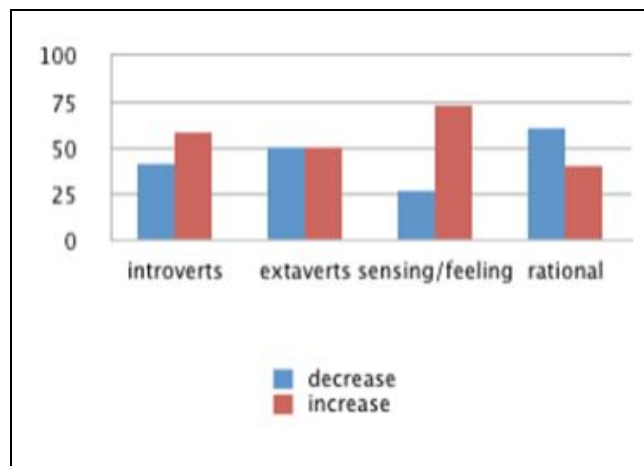


Figure 3

3.3. Pulse Changes Depend Rather on Sex and Personality Type than on Type of Communication

We recorded pulse of 26 women and 22 men in total. 61,5% women and 32% men reacted with increased pulse levels in response to the interview, while 68% of men and only 38,5% females revealed pulse decrease. Visualization of this result is shown in the Table 2. During face to face meetings 33.3% women and 66.6% men showed decrease in heart rate while 54.5% of women and 75% tested men in writing. Engagement, excitement, anxiety and boldness might influence physiological responses such as pulse levels. Since listed above features are strictly related with personality types, we classified people among four different groups: introverts, extraverts, emotional and rational thinking people in relation to the pulse measurements. Data are listed in Table 3. and visualized in Fig. 2.

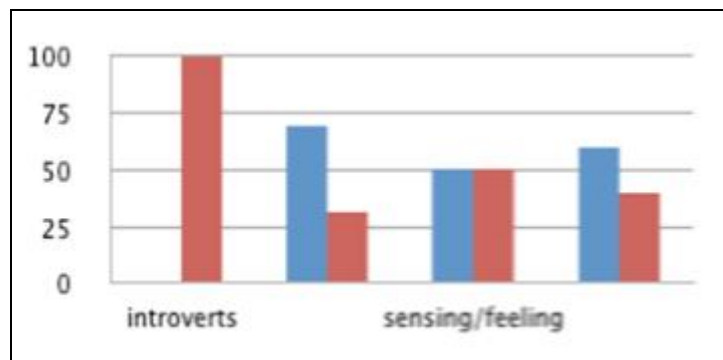


Figure 4

Fig. 4 (up). Percentage distribution of people with different personality types in face to face meeting. Fig. 4 (bottom). Distribution of people with different personality types in the writing type of communication.

	Direct [Nr;%]		Written [Nr;%]	
	Decrease	Increase	Decrease	Increase
Introverts	5; 41	7; 58	0; 0	6; 100
Extraverts	7; 50	7; 50	11; 69	5; 31
Sensing/Feeling	3; 27	8; 73	6; 50	6; 50
Rational	9; 60	6; 40	6; 60	4; 40

Table 3

Table 3. Number and percentage representation of students divided in groups for personality and communication types.  $N_d=26$  students of direct communication and  $N_w=22$  students of written communication.

In both types of meetings introvert people increased pulse in opposition to rational personalities, where was observed pulse drop. Emotional people displayed pulse increase only in direct type of communication. Extraverts were much more relaxed in written communication: 69% tested students had pulse decrease.

3.4. Cognitive-Communication Disorders

Asking questions in response to questions and number of mistakes in given answers are good markers to analyze comprehension levels in communication. In case of written communication in our study, students had no opportunity to ask questions. We could analyze the level of their understanding later in feedback tests and analyzing their content in answers. In most cases the written group

of students answered correctly. Unfortunately often they forgot to give answer for the second part of the question, which was asking them to explain an issue. We are not able to judge, whether students skipped this part of question because they didn't know the answer, or simply they missed it because they were not careful enough in reading the tasks. In this type of communication however we were able to count number of word mistakes relative to number of words. By mistake we mean either a word, which was written in wrong order or word's deletions. We counted the number of words in total, described the general form of writing (if verses are regular or irregular), if words are correct, if there are grammar mistakes, if letters in words are written wrong (reversed or deleted), finally if mistaken words are corrected. We tried to screen all these parameters regarding different personality types. Data are presented in

Personality	Average number of words	Orthographic mistakes	Irregular verses	Errors in words	Corrected words
Extraverts	76	43%	67%	57%	7%
Introverts	56	41%	53%	59%	7,1%
Feeling	63	33%	47%	66%	11%
Rational	71	31%	62%	60,5%	4,2%

Table 4

Table 4. Cognitive parameters in writing of tested students. Analysis based on subsequent numbers of people: Extraverts: 11 women, 11 men; Introverts: 6 women, 12men; Feeling: 9 women, 5 men, Rational: 9 women, 20 men.

Interestingly we observed that personality type may be associated with preference to the direction of studies. Among extraverts, 77% of students studied humanistic subjects, while only 23 % attended strict subjects. Feeling type of people dominated in 91% in humanistic students. In opposition, 61% introverts studied strict subjects, while only 39% studied humanistic directions. Similar trend was observed in case of rational type of people, where 66% studied strict directions and 44% studied humanistic subjects.

In case of direct communication we could count the number of questions asked by tested students, and we could assume, which questions were most difficult to answer regarding clarity of a question. Among 19 tested students, 15 of them asked additional questions. The average of asked questions was 2.5 per meeting. Asking questions is related also with engagement levels, but here we included only questions related with understanding. In all cases there were questions concerning the meaning, for example: "What means a free time?", "What means a project – does it mean a professional or any kind of project?", "What means hierarchic structure?" The level of comprehension could be additionally expressed by not answering to the question, but again, we were not able to judge if this lack of answer was caused by lack of understanding or by other reasons.

### 3.5. Students Opinions

After the simulated interview meeting, we asked students to give us feedback related with stress levels and the quality of given answers induced by the experimental task. Students were asked to score listed above parameters from the lowest value 1 up to the highest 6. Writing form of the interview was less stressful. Engagement and quality levels were scored slightly higher in the writing group of students than in the group of students participating in direct meeting. Women felt equally stressful in both types of communication types while men were more stressed only in direct interaction with the interviewer. While women were more engaged in answering questions in writing form, men were more engaged in speaking. Quality of the meeting was scored higher by men than by women although comprehension levels were scored similarly for both men and women in two types of the interview. At the end of the experiment we asked students to tell about what kind of communication type they prefer and why. 71% women and 75% men prefer direct type of the meeting, because they are able to control the meeting, to observe the people participating in the communication, to clarify the message if there are misunderstandings and finally they prefer verbal communication because it gets more information. 29% women and 19.5% men prefer written type of communication because it is less stressful, there is a time to think about how to answer, and because it is documented.

## 4. Summary and Discussion

Novel situation, no preparation for the task, pulse- and video-recordings induces emotional stress (Saslow L.R et al., 2013). We observed changes in behaviour based on changes in physiology detected by used methods. Previous study has shown that this kind of stress inhibits areas of the brain related to verbal memory (Buchanan et al., 2014; Newcomer et al., 1999), complex thought, and activates the hypothalamus–pituitary–adrenal (HPA) axis to release stress hormones (Saslow et al., 2013). Further impairment of cognition is caused by feedback signals from released hormones acting on glucocorticoid receptors inside the brain (Arnsten, 2009; Kern et al., 2008; Lupien et al., 1998; Sapolsky et al., 2000; Seeman et al., 2001). Other research has shown that acute stress during stressful speech tasks impairs functioning of prefrontal cortex (Arnsten, 2009), including reduced cognitive flexibility (Alexander et al., 2007) and working memory (Luethi et al., 2008).

This investigation was the first attempt to characterize the effect of first meetings on pulse changes, which indirectly reflect physiological responses to stress. The experiment design required analysis of single trials to simulate unrepeatable situations analogous to those occurring in real life. We discovered that meetings may induce four main types of changes in heart rate: increase, decrease, hill and depression. Less than 1% of tested people displayed no pulse changes during the experiment. We assume that observed pulse variability indirectly corresponded to different types of stress responses during first meeting: either slow and long increase of stress levels, or rapid increase of stress and then slow habituation reflected in pulse decrease. In other cases we observed fast reduction of physiological stress depicted in long or short pulse drop (Fig.3). We put main focus on relation of pulse changes to gender, personality and communication types, since all these features are important in quality of personal interactions during meetings (quality of language, answering and asking).

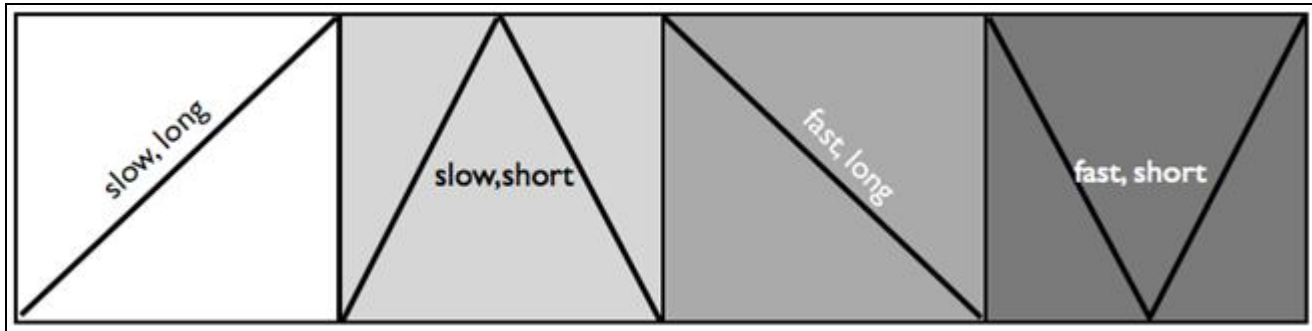


Figure 5

Fig. 5. The schematic characteristics of four types of pulse changes during first meetings. Physiological responses might be either slow or fast both in generation as well as in reduction of stress responses.

Our results from pulse recordings supported the fact, that writing is less stressful than speaking, but interestingly, generated during the first meeting stress responses seem to be more affected by type of gender, education and personality, than type of communication. This fact may be useful to improve the quality of meetings during job interviews and conferences by proper design of questions and tasks, however deeper studies need to be done regarding this issue. Especially there is need to study physiology during professional meetings in relation to entrained self-controlling mechanisms for example breathing techniques. Independent analysis of four different types of questions: informational, motivational, problem solving and emotional combined with physiological responses would tell more about the nature of stress sources, which would allow deeper understanding of human behavior during interpersonal interaction.

## 5. Acknowledgments

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Annexure

## Supplementary Materials

- Name:
- Age:
- Gender:
- Nationality:
- Job/Studies:

## ➤ TEST I

1. What is your job now?
2. Your actual professional goal?
3. What are you doing to reach this goal?
4. What are your professional successes?
5. Which projects, which you have already realized made you the most happy and why?
6. Do you realize some optional projects for pleasure?
7. Do you prefer to work in hierarchic or equal structure?
8. Do you prefer team or individual work?
9. What are you doing in your free time?
10. Do you have any passion/hobby?
11. What is your last read book?
12. Are you a member of some associations, sport groups, professional groups, etc.?

## ➤ TEST II Concerns the previous test

1. How do you score your answers? (Scale 1-min. to 6-max.)
2. How do you score the degree of your engagement (Scale 1-min. to 6-max.)
3. How do you score the degree of clarity/understanding of questions? (Scale 1-min. to 6-max.)
4. How do you score your stress level (Scale 1-min. to 6-max.). If you felt stressed, write what was the reason (new situation, new person, a question, etc...)
5. Which question was the easiest and why?
6. Which question was the most difficult and why?
7. Which question induced your emotions? What type of emotion it was, and what was the reason?
8. Did you sleep well last night?
9. How do you feel today (Scale 1-min. to 6-max.)
10. Can you control your stress?
11. Which type of communication in business meetings would you prefer: direct face to face, via phone, or indirect by writing? Explain in few words, why.