

## Maternal Heart Rate Tracings in Labor as A Reflection of Personality Traits

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### ABSTRACT

Personality traits are thought to be 50% heritable from pleiotropic genes. Most frequently studied genes for personality traits are those of neurotransmitters. Since neurotransmitters control the autonomic nervous system, genes for neurotransmitters are candidate genes for personality traits.

Heart rate and heart rate variability in response to various stimuli are thought to be an expression primarily of the autonomic nervous system and the metabolic rate. Studying heart rate and variability could reveal both autonomic nervous system function as well as personality traits. Maternal heart tracings via finger pulse oximetry are routinely a part of labor monitoring. Although not as standardized as state of the art adult heart rate variability measures, maternal heart tracings should correlate with personality testing.

All patients seen in office were logged on an Excel spread sheet as to their diagnoses and were offered as a way of understanding personality connections with illness an online personality test to test aggressiveness as a sympathetic nervous system correlate as well as parasympathetic (non-aggressiveness) nervous system correlates. The test used is NPA (Narcissism, Perfectionism, and Aggression) personality test, an online test based on genetic and physiologic roots of personality.

Portions of 51 laboring patients' heart rate tracings were correlated with their results on the NPA personality test.

Results showed that maternal heart rate was higher and our variability measure was lower for those with aggressive trait. Decelerations of maternal heart rate from baseline rate were found in 6 of 30 of those without aggressive trait and in none of those with aggressive trait. Accelerations of maternal heart rate from baseline rate were found in 3 of 21 of those with aggressive trait and in none of those without aggressive trait consistent with sympathetic effects on behavioral aggression and on heart rate.

### Keywords

Genetics, Heart rate, Maternal, Personality, Pleiotrophy.

### Introduction

Autonomic nervous system along with metabolic rate controls baseline heart rate [1]. In laboring patients, inputs of stress of labor and accompanying inflammation factors play a role as well. Heart rate variability is lessened by sympathetic nervous system factors and increased by parasympathetic factors in a complex interaction. Periodic change from baseline of heart rate acceleration in labor are seen most often with valsalva maneuver and "pushing" during uterine contractions, but acceleration may result from other

maternal hemodynamic factors which could both decrease venous return to the heart and increase blood flow from auto-infusion from the contracting uterus. Heart rate acceleration seems to occur also as emotional response of some women in labor. Periodic change of heart rate decelerations has been found randomly in a study of non-laboring pregnant patients, and decelerations were found in a study of women with dehydration in labor where the authors hypothesized that auto-infusion of blood from the contracting uterus caused a vagal effect [2-7].

Catecholamine genes in large part control production and activity of the autonomic nervous system neurotransmission. And the

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science of personality traits has advanced to a point where the catecholamine genes as well as other genes have been found to be associated. Cloninger's Novelty Seeking trait was one of the first traits linked with several dopamine genes including DRD4 7R, a low activity dopamine receptor. Impulsiveness has been linked also to the dopamine genes, DBH (dopamine beta hydroxylase) being consistently associated. Extraversion has had genetic links found. There is, in fact, extensive data showing linkage of catecholamine genes of autonomic nervous system with personality factors [8-27].

The NPA personality test deals with the autonomic nervous system effects on behavior [28]. Full explanation of the theory of the test is beyond the scope of this article and is available online. Briefly the theory called NPA (Narcissism, Perfectionism and Aggression) Theory of personality holds that sympathetic nervous system related Aggression is a widespread personality trait along with Narcissism and Perfectionism. Any given individual has one of more of these as a prime genetic personality trait. Theoretically besides genetic testing each individual can be classified through observation of his behavior or by self-reporting as to his NPA makeup. Because it is a physiologic system, it is theorized to have relevance to health status as well as to improved self-knowledge [29-31].

### Hypothesis

Based on known effects of sympathetic activity on the heart, the hypothesis was that patients with aggressive (sympathetic) personality would show more heart rate accelerations compared to patients with non-aggressive personality. A second endpoint would be that patients with aggressive (sympathetic) personality would have less of our heart rate variability measure compared to patients with non-aggressive personality. A third endpoint was that patients with aggressive personality would show higher baseline heart rate.

### Methods

This study uses data from a large pilot study of associations of personality with clinical factors of over 4000 patients of one ob-gyn physician. Data was collected by reviewing the patients' office history questionnaires supplemented by physician interview and recording each positive finding on an Excel spreadsheet. The categories included all standard medical factors such as demographics, previous medical diagnoses and surgeries as well as those pertaining to obstetrics and gynecology history. There were 240 categories of medical history and demographic queries set up on the Excel spreadsheet that were available for recording any positives for each patient seen. The data entry was done on the day of the patient's visit in the office. Some of the data has been reported in previous papers on personality and illness [32].

Obstetric patients for this study delivered at a low risk obstetric hospital with admission criteria of 36 weeks gestation. Examples of hospital exclusion criteria for the hospital are severe pre-eclampsia, diabetes treated with insulin, and placenta previa as well as maternal compromise by disease such as chronic renal failure and cardiomyopathy. All patients for the study met the hospital admission criteria even if having some underlying

diagnoses requiring assessment in prenatal visits. Essentially all patients have regional anesthesia in labor.

Heart rate tracings of patients were obtained during their admission for labor using pulse oximetry device based on photoplethysmography (Radical 7 pulse oximeter; Masimo Corporation, Irvine, CA) with monitor attached to finger or toe.

During or shortly after labor, the archived alternating folded paper copy of each of the laboring patient's heart rate tracings was opened randomly as in a deck of cards and 9-18 minutes were copied. These maternal heart rate tracings were labeled only with a patient ID number. Opening the standard alternating folded heart rate tracings paper archive as in cutting a deck of cards for a card game and copying the 9 minutes or in some cases 18 minutes of the exposed recorded maternal heart rates was the method of randomization of heart rate data. First, the mean heart rate was determined following the American College of Obstetricians and Gynecologists criteria for reading fetal heart rate tracings by finding the rate by inspection that the heart tracing hovered around. Second, each tracing was labeled as having either normal heart rate variability, decreased heart rate variability, or increased heart rate variability.

Following standard American College of Obstetricians and Gynecologists criteria for fetal heart rate tracings, normal heart rate variability has beat-to-beat variability of 1-3 beats per minute and has accelerations lasting 15 seconds of 15 beats per minute. Increased heart rate variability includes the feature of having wide and rapid oscillations of the heart rate with a mean oscillatory amplitude of more than 35 beats per minute consistently over at least 5 minutes of the tracing. Decreased heart rate variability features lack of accelerations of at least 15 beats per minute for 15 seconds and consistently less than 1-3 beats per minute of beat-to-beat change in heart rate variability.

The third parameter assessed was periodic change. These changes, called either decelerations and accelerations, were searched for on all patients' tracings. These changes were classified as such according to standard American College of Obstetricians and Gynecologists criteria for fetal heart tracings interpretation whereby periodic changes of decelerations or accelerations can be of varying magnitude but must last more than 15 seconds from onset to return to baseline heart rate yielding a visible hump in the line of heart rate tracing. In the fetus, decelerations can be noted in two patterns, late and variable. Late decelerations begin after the apex of uterine contraction. Any deceleration that does not meet late criteria is classified as a variable deceleration.

Recent studies use ECG data to characterize in great detail parameters of maternal heart rate variability but these methods are investigational in labor and delivery units and not used in our hospital [33,34]. In this study, maternal heart rate, heart rate variability and periodic change of decelerations or accelerations were read as the fetal heart tracings for these parameters are read in standard clinical practice as detailed above [35].

All patients were offered the online NPA personality test as seen in the office. The study population for this paper were the patients who had labored and who had results available for the online personality test.

This study was judged exempt and not submitted for Institutional Review Board approval as it is one physician's collection and study of her own patients' de-identified data.

Statistical method planned was t test for mean maternal heart rate difference and Chi Square for differences in outcomes of our measure of heart rate variability and occurrences of periodic changes of decelerations and accelerations between the two groups to be compared.

## Results

For the entire database, 4028 patients were seen in the office where clinical data was collected and where each was offered the online personality test by one ob-gyn physician. 1235 patients took the online test. Almost all patients were self-identified non-Hispanic caucasian; the patient population was five percent African American. The percentage of the entire population who took the test was 31% while 22% of all African-American patients took the online test. Mean of patient ages who took the test was 39 while mean of patient ages for the entire patient population was 41. Results of the NPA online personality test showed that 50% of patients had aggressive personality while 50% had non-aggressive personality.

Maternal heart rate tracings for mean heart rate, our measure of approximation of heart rate variability and periodic changes of accelerations and decelerations during labor were analyzed for the 51 pregnant patients who had taken the online personality test.

Of the tracings with periodic changes of accelerations in the baseline heart rate (varying in magnitude of 15-30 beats per minute), all three patients had aggressive personality. Three of 21 patients with aggressive personality had accelerations.

Of the tracings with periodic change from baseline heart rate of decelerations (in magnitude of 10-20 beats per minute), none had aggressive personality. Four of 30 patients with non-aggressive personality had decelerations. Patients who showed aggressive personality were the only patients having periodic change of accelerations from the baseline heart rate, and those without aggressive personality were the only patients having decelerations from the baseline heart rate. No late decelerations were noted. Chi square or other statistical tests were not done as there was no occurrence of the variable to be measured in one side of each comparison group and groups were small so that the assumption was that little could be concluded.

Maternal heart rate was non-significantly (two tailed P value =0.5475, CI=95% -5.75-10.71) higher (83 v 81) for those with aggressive personality. Given the very narrow window of normal heart rate in any pregnant patient, a much larger study of mean

heart rates would be necessary to demonstrate significance. Our measure of an approximation of maternal heart rate variability was non-significantly (p .82625) lower (4 of 21 of patients with aggressive personality with decreased heart rate variability vs 5 of 30 patients with non-aggressive personality with decreased heart rate variability). No patients in the study had increased heart rate variability.

ID #	age	race	test	meanHR	HRV	Periodic	Any clinical diagnoses
72634	22	c	A	73	nl		
42368	27	c	A	80	nl		
60220	33	c	A	85	nl		
2575	39	c	A	85	de		Irregular heartbeat
7316	35	c	A	110	nl		
65269	39	c	A	80	nl		hypertension
63575	20	c	A	90	nl		aura migraine
71903	22	c	A	60	nl		
73261	24	aa	A	90	nl	Acc	seizure disorder
71586	25	c	A	65	nl		
73327	25	c	A	60	nl		tobacco abuse
75700	29	c	A	80	nl	Acc	
66131	29	c	A	87	de		
61613	30	c	A	90	nl		migraine
36674	31	c	A	73	nl		
74244	31	c	A	85	nl		tachycardia history
53585	35	c	A	105	nl		
71043	26	aa	A	70	nl	Acc	
71903	22	c	A	90	de		
75038	23	c	A	110	nl		
46737	30	c	A	90	de		Hypertension, diabetes
75761	22	c	nonA	85	de		
42874	24	c	nonA	110	nl		
56433	25	c	nonA	78	nl	Dec	
75279	29	c	nonA	85	nl		
35775	30	c	nonA	85	de		hypertension
14300	38	c	nonA	75	nl		
40998	38	aa	nonA	80	nl		
60900	22	aa	nonA	75	nl	Dec	Seizure disorder
74008	24	c	nonA	105	nl		hypertension
35047	27	c	nonA	80	nl		
15810	35	c	nonA	80	nl		uterine fibroids
66166	19	c	nonA	65	nl		thyroid, hypertension
75040	20	c	nonA	82	nl	Dec	
76193	20	c	nonA	65	nl		
66845	25	c	nonA	95	nl		
61080	25	c	nonA	95	nl		Von Willibrand's
34019	26	c	nonA	52	de		
73416	28	c	nonA	70	nl		

8009	28	c	nonA	95	nl		hypertension, diabetes
2920	29	c	nonA	60	de	Dec	
12153	29	c	nonA	110	nl		thyroid disorder
72889	30	c	nonA	80	nl		
74761	30	c	nonA	70	nl		hypertension
65699	35	c	nonA	85	de		
70528	35	c	nonA	60	nl	Dec	
53734	30	aa	nonA	70	nl		
129672	30	c	nonA	70	nl		Chrohn's dx
5139	30	c	nonA	90	nl	Dec	
75193	35	c	nonA	85	nl		Pp hemorrhage
75815	22	c	nonA	100	nl		

**Table 1:** Patient demographics and results.

test: Personality Test Results; HR: Heart Rate; HRV: Heart Rate Variability; Periodic: Change from Baseline as to Accelerations or Decelerations; c: Caucasian, aa: African-American; A: Aggressive, nonA: Nonaggressive; de: Decreased Variability, nl: normal; Dec: decelerations, Acc: Accelerations.

## Discussion

NPA personality test as a surrogate for catecholamine tone showed linkage with expected changes from baseline in the heart rate; that is, aggressive personality trended to adrenergic effects and non-aggressive personality trended to cholinergic effects though the small numbers of patients made no definite conclusions possible. Given the very narrow range of normal heart rate in pregnant patients, a much larger study would be required to demonstrate a significant difference between groups studied. But the trends seen in mean heart rate and in our measure of an approximation of heart rate variability as well as periodic changes are in exactly the right direction hypothesized though a much larger study would be required. But these findings add information on the role of personality traits as they impact heart function.

Personality theories are multiple as is often the case when any area of study is in its infancy and little is known. Early researchers such as Eysenck posited that brain function caused personality, and his work contributed to the current Big Five personality traits theory. The Big Five traits are Openness to Experience, Conscientiousness, Extraversion, Agreeableness, and Neuroticism. The other major physiologic theory is the Cloninger genetic traits of Novelty-seeking, Reward Dependence, Harm Avoidance and Persistence. A very large volume of research has been done on these systems yet no definite genes have been proven to cause these traits though many studies have shown correlations. The NPA theory of traits is focused just on the autonomic nervous system genes and their pleotropic effects.

Our results differed from those in a study done in Tel Aviv (3) where no maternal heart rate decelerations were found, and they reviewed a much longer time frame of each patient (90 minutes) though they did have the same number of patients (51) in their study. One explanation may be population differences; that is, our

entire patient population had 50% incidence of non-aggressive personality and our study patients in labor had non-significantly higher 59% incidence of non-aggressive personality whereas the Tel Aviv population could have had much less as populations are known to vary remarkably in frequency of alleles associated with physiologic traits; personality traits as they reflect the sympathetic nervous system are not an exception to this. Another explanation may relate to clinical confounders not taken into account in our study as this study did not aim to study obstetric findings such as duration and complexity of labour. In a study in Cleveland, Ohio, (2) maternal heart rate decelerations with or slightly after contractions were found in those patients with dehydration or intravascular volume depletion when the contracting uterus auto-infuses 500 cc blood, thus lowering the maternal heart rate. Accelerations as our study found however have been often described in normal patients during maternal valsalva in pushing efforts and represent the decrease in return of blood to the heart and thus thought to represent a compensatory increase in heart rate. In a study in South Africa obstetrics clinic population not in labor, both accelerations and/or decelerations were found in ten percent of patients and appeared to be random events, though this would not rule out intrinsic confounding genetic differences as a cause of the occurrences of periodic accelerations and decelerations [7].

Limitations of this study are small numbers of patients as well as short length of sampling of heart rate and our measure that approximated heart rate variability. Larger studies will either show that those with aggressive personality uniquely have accelerations or that this study's finding of a difference in occurrence of accelerations and decelerations in laboring patients of different personality test results was a random finding. While other studies have shown that decelerations were somewhat random, personality traits as they impact decelerations have not been previously studied.

The method we used to classify and approximate maternal heart rate variability was not quantitative but derived at by inspection, a method not sensitive enough to classify variability on a fine scale nor was our method sensitive enough to take into account variations in heart rate variability based on such factors as sinus tachycardia, a common finding in young women and one that affects heart rate variability.

On the other hand, mean heart rate and periodic change of accelerations and decelerations can be classified by inspection with a reasonable degree of reproducibility when done by the same method used to classify fetal heart rate parameters in standard clinical practice. In this method decelerations can be very modest in magnitude but are recognizable by their shape whether late or variable as they depart and then return visibly from the baseline heart rate tracing forming a hump in the line tracing the heart rate.

Another limitation is the lack of validation of the NPA online personality test used though the use of "fight or flight" questions to reflect the sympathetic nervous system strength in personality seems intuitively valid enough until a better test comes along.

And the lower rate of taking the online test in pregnant women compared to the general population as only 51 of 229 (22%) of pregnant patients took the test while 1235 of 4028 (31%) in the general population of office patients took the online test should be noted though the discordance in percent test-takers is not remarkably different between the pregnant patients and the general population of patients.

## Conclusion

When clinicians have whole genome information on patients and when genetic effects are better understood, the era of personal genomics will be here and will no doubt allow better treatment of patients. In the absence of such information, this study involving as it did the use of a personality test as a surrogate for aggressiveness genes was an effort to better understand the correlation between personality traits and physiology and the genes that connect them [36,37].

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