The Emergenetics® Profile Technical Report

The Office of Research

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Introduction

The value of a self-reported personality test depends on its usefulness.

The Emergenetics® Profile was developed to better capture how individuals prefer to think, learn, problem-solve, and communicate. To best capture these complex human behaviors, the co-creators used several theories, including Emergenetics theory, to take a holistic and integrated approach to display an individual's unique ways of thinking and behaving.

The co-creators of Emergenetics, faced with the current personality-survey market, felt a widespread need for a robust yet straightforward personality tool. They also felt that a new tool needed to follow professional test development standards and provide actionable information that can be used in daily life, thus creating the Emergenetics Profile.

As the co-creators developed a useful personality assessment, they began with a comprehensive review of decades of academic investigations, including:

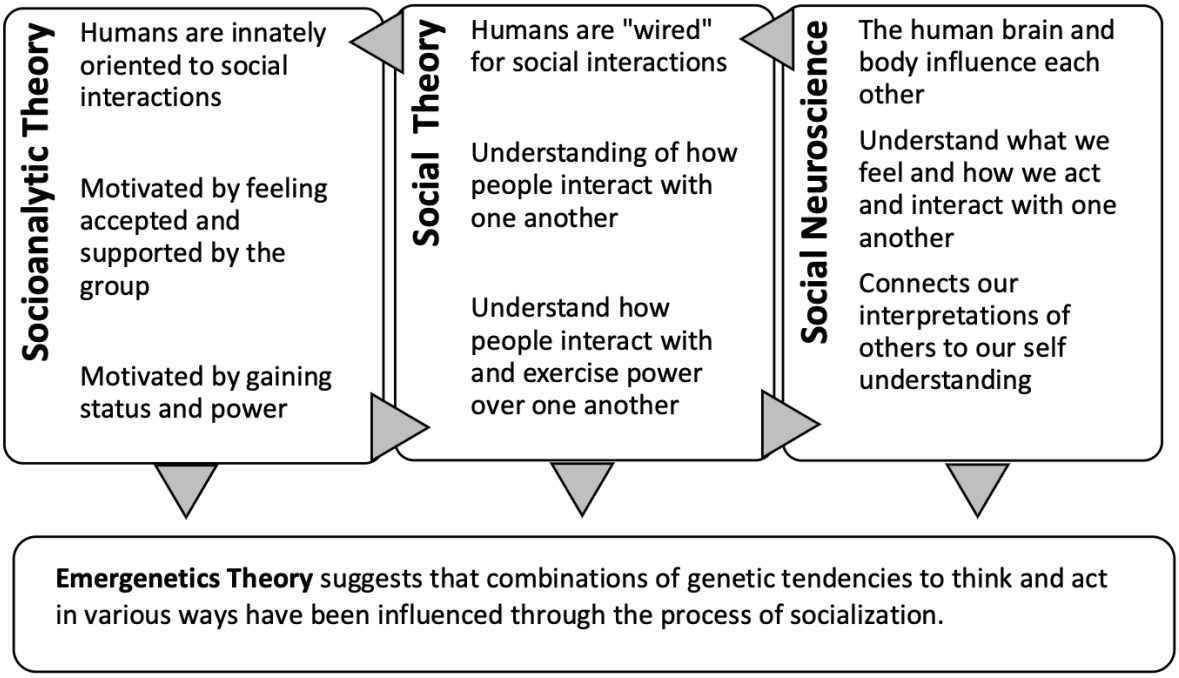
- The study of personality dates back to the late 1800s, with social science researchers beginning by investigating the human lexicon or vocabulary used to describe human behaviors.[1,2] As social scientists continued to examine the human lexicon, two scientists, Tupes and Christal,[3] found that words used to describe human personality could be clustered into five domains referred to as the five-factor model or FFM.[4]
- Theories including socioanalytic and social theory were examined.
    - Socioanalytic theory broadly proposes that humans are inherently social and motivated by emotions and a sense of belonging.
    - Social theory also broadly proposes that humans are inherently social and focuses on understanding how people interact and exercise power over others.
- Additional theories such as social neuroscience and Emergenetics have also informed the continued development of the tool.
    - Social neuroscience broadly focuses on how human brains and bodily physiology come together to influence behavior. In other words, understanding how we feel and interact and connecting our self-understanding to our interactions.
    - Emergenetics theory exists at the integration of these theories and suggests that combinations of genetic tendencies to think and act in various ways have been influenced through the process of socialization.
- An extensive review was conducted of job-related factors measured in assessment centers, research data from Sperry and Gazzaniga's study of corpus callosotomy patients, and monozygotic and dizygotic twin studies conducted at the University of Minnesota.[3–11]
- They also identified that current assessments often fall into three categories:
    - Diagnostic: Diagnostic assessments are not designed to be used in healthy individuals.[12]
    - Academic: Academic instruments are often lengthy and difficult to implement outside a lab.[9,13,14]
    - Lay-design: Lay-designed instruments are often not rigorous and fail to meet minimal professional standards.[15]

Importantly, some scientists have argued that for personality assessments to be useful outside of the laboratory environment, they should use nomological web clusters (clusters that form naturally) rather than the original five-factor model based on lexical analysis.[5,10,16] Forming clusters of homogenous personality

variables using nomological techniques can provide a more useful framework that creates actionable information for daily life.

The Emergenetics survey items were assembled to form a nomological and empirical approach to behavior based on simplified verifiable observation. Emergenetics measures fundamental preferences for thinking and behaving at a situational level. These fundamental preferences follow socioanalytic theory and social theory, which suggest that specific human behaviors evolved as people learned to get along with each other, gain status, secure power, and understand their place in the world.[16,17] Social neuroscience and Emergenetics theory have grown and evolved from the foundation of socioanalytic and social theories. Social neuroscience connects the human brain and the body's physiology to understand behavior and how we interact with one another.[18] By continuing to grow, the more comprehensive theories of social neuroscience and Emergenetics theory allow for the capacity to incorporate global and societal changes.[19] Importantly, this allows Emergenetics to be at the forefront of the modern world, adapting to changing demands and meeting the needs of individuals.

Figure 1. The influences between socioanalytic theory, social theory, social neuroscience, and Emergenetics theory



What does all this mean?

The Emergenetics Profile was developed to address the limitation of current personality assessments and provide a tool with practical and actionable implications. The founders incorporated decades of previous research to build a comprehensive and useful tool that aids in self-understanding and provides a framework to build a supportive and successful team environment as well as universal understanding in all settings and environments.

A Nomological Framework

A nomological framework provides a robust model that encourages participants to think of their Profiles as useful patterns that influence how they may interact with others. Importantly, while this approach allows for individuals to identify and think about important patterns in their own behavior and thinking, it does not constrain interpersonal interactions and allows for all individuals to engage in all behaviors and thinking patterns.

Below are a few examples of the nomological items gathered by the co-creators during the development of the Emergenetics Profile:

- Enjoys problem-solving and figuring out how things work
- Tends to be methodical
- Checks in with others for decision making
- Bases decisions on intuition rather than rigorous analysis
- Is willing to engage in dialogue or introspection
- Depending on the situation, takes a calm or driven approach
- Decides easily or is open to revision

As with all self-descriptive instruments, the Emergenetics Profile does not necessarily predict specific skills; however, when delivered in combination with an interactive workshop, participants are exposed to:

- Basic tools to improve job performance and communication
- Basic motivational drivers within a work environment
- Strengths and interests based on a heightened knowledge of personal preferences
- Techniques to understand how behavior affects others and how to translate this knowledge into more confidence and self-acceptance when working with others
- Ways to build a collaborative organizational workforce
- Tools for engaging in meaningful dialogue and information about the way they go about work

What does all this mean?
The Emergenetics Profile uses a nomological framework to allow for individuals to self-identify with all thinking preferences and behaviors rather than constraining individuals to a particular type of thinking or behaving.

Professional Development of an Instrument

Put simply; a professionally developed survey should:

- Include a useful theory of behavior (i.e., practical)
- Be stable (i.e., reliable)
- Accurately measure what it is supposed to measure (i.e., valid)

These processes are expressly described in the Standards for Educational and Psychological Testing, an internationally accepted digest of best survey practices.[20] The Emergenetics tool was developed in line with these standards that specify the criteria that all surveys must meet to be considered reputable.

The Standards for Educational and Psychological Testing

1. Items that load on a specific factor must be consistent with each other and with the factor score.
2. Factors within the test that are associated with each other should correlate, and factors that are independent should not.
3. Scores on the survey should directly relate to the content, construct, or criterion it is supposed to measure.
4. Items should resemble "legitimate" questions.
5. To an extent justified by the intended uses of the survey, steps should be taken to keep scores and scoring methods secure from tampering or observation by unauthorized people, detect and prevent faking (whether good or bad), and limit the ability of users to be 'coached' on how to make results more favorable.*

* This standard largely applies to instruments used for high stakes selection, compensation, or other administrative decisions,[21] and not personal development or self-reflection; it did not factor heavily into the development of this instrument.

Following the guidelines outlined above, the co-creators took the following steps in developing the Emergenetics tool:

- Assembled lists of nomological items
- Constructed the questionnaire
- Administered the questionnaire to participants attending workshops
- Analyzed the questionnaire using a factor analysis
    - Examined scree-plots to identify discrete factors that were both statistically and rationally related
- Repeated this process to identify items that formed factors or clusters

The results were seven specific homogenous factors of item composites that define a specific personality space.[17] The identified factors had suitable inter-item reliabilities within each factor and were considered theoretically useful. Importantly, dysfunctional and socially undesirable items such as neuroticism, morality, ethics, and so forth were outside the scope of the survey and were excluded from the analysis.

Since the intent of the Profile was to provide robust and useful comparisons between and among individuals, two steps were taken to facilitate this process:

1. Raw scores for each factor were converted into normative percentile scores.
2. The four thinking preferences are additionally represented as a percentage mix.
    - This provides individuals with a robust profile (and partially corrects for survey-response bias) that accounts for what a person themselves considers important, how these preferences interact, and how strongly they present these preferences in a relationship.

Importantly, Emergenetics separates behavioral and thinking preferences. This separation improves upon a historical limitation in which there has been a tendency for many personality profiles to confound thinking preferences with behavioral preferences.

A Note About Social Desirability

Self-reported profiles have been criticized for relying on honesty and accurate self-awareness and often evaluate the internal consistency of scales to control for individuals responding to items based on social desirability. In other words, some items evaluate whether a person honestly feels that way about themselves or are answering based on larger social pressure to express or not express that behavior or thinking preference. Although high levels of control of response items are theoretically appealing, it presents certain problems because it is often difficult, if not impossible, to separate the desirability of personality-related items from their content. Removing socially desirable items may make it difficult to measure traits that are themselves desirable in certain situations. Because of these concerns and the fact that the Profile is not presented within a high-stakes environment, social desirability scales were not included in the Profile. This in no way reduces its usefulness. Two large within-person studies found small differences in mean personality test scores when the first test was for selection purposes and the second was for developmental purposes or vice versa.[22] Together, the results suggested that under a wide array of realistic applicant scenarios, these socially desirable responses neither affect the criterion-related validity of personality tests nor the mean performance levels in those selected.

What does all this mean?
The Emergenetics Profile was developed in line with the educational and psychological standards. The seven Attributes of the Emergenetics Profile (four thinking Attributes and three behavioral Attributes) are based on a theory that is useful and practical, with results that are reliable and valid. The following sections will demonstrate the reliability and validity of the Attributes.

The Emergenetics Profile

The Emergenetics Profile includes:

- 100 items
- Seven Likert-scaled normative scored factors (with 8-11 items per factor)
- Within-factor inter-item reliabilities ranging between $\alpha = 0.71$ and $\alpha = 0.83$
- Ten-year test-retest reliabilities between $r = .68$ and $r = .77$
- Construct validation with FFM, convergent/discriminate validation, and face validity
- Four thinking-style preferences based on percentile strength (interpersonal measure) and percentage mix (intrapersonal measure):
    - Analytical (ANA): having an interest in problem-solving, understanding complex subjects, and mental analysis
    - Structural (STR): prefers rules and regulations, stability, a hands-on approach, and avoiding risk
    - Social (SOC): intuitive about people, social concerns, working in teams, seeks approval from others
    - Conceptual (CON): intuitive about ideas, seeks unique activities, experimentation, futuristic
- Three behavioral descriptions based on percentile strength (interpersonal measure):
    - Expressiveness (EXP): based on a continuum from quiet and introspective to gregarious and exuberant
    - Assertiveness (ASR): based on a continuum from calm and peacekeeping to fast-paced and driven
    - Flexibility (FLX): based on a continuum from firm and focused to energized by change

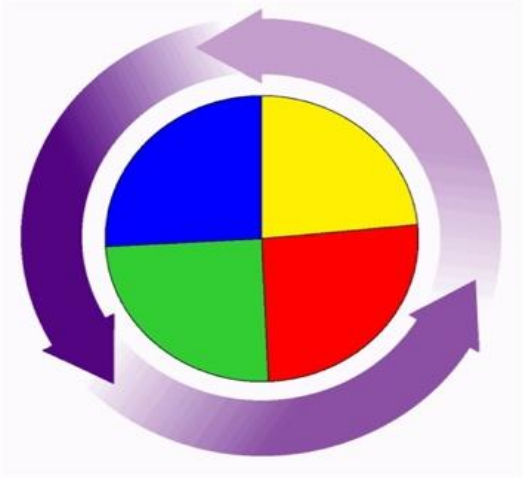
EMERGENETICS® | PROFILE

SAMPLE PROFILE

HOW YOU THINK: PERCENTAGES

ANALYTICAL = 26%
- Clear thinker
- Logical problem solver
- Data driven
- Rational
- Learns by mental analysis

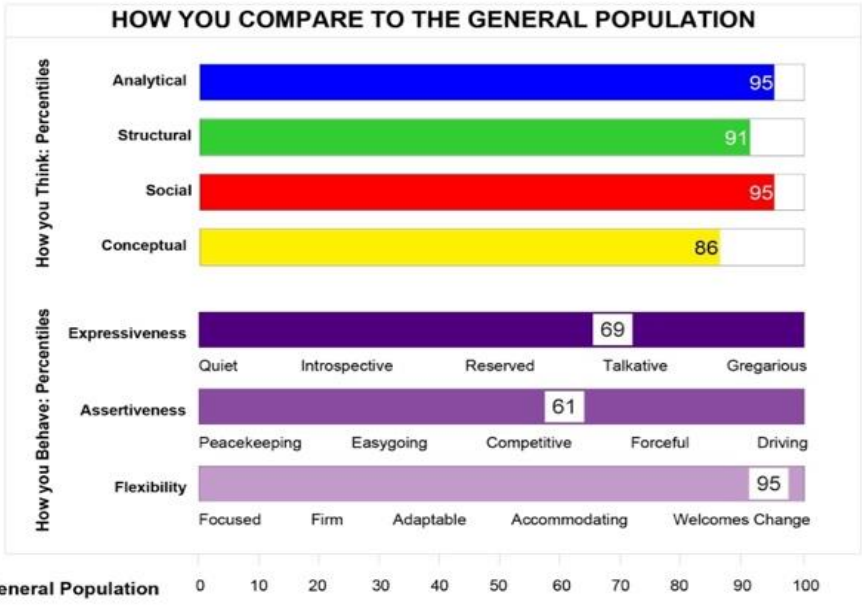
CONCEPTUAL = 23%
- Imaginative
- Intuitive about ideas
- Visionary
- Enjoys the unusual
- Learns by experimenting



STRUCTURAL = 25%
- Practical thinker
- Likes guidelines
- Cautious of new ideas
- Predictable
- Learns by doing

SOCIAL = 26%
- Relational
- Intuitive about people
- Socially aware
- Empathic
- Learns from others

HOW YOU COMPARE TO THE GENERAL POPULATION



 Geil Browning, Ph.D. / Wendell Williams, Ph.D.

The Practicality of the Emergenetics Profile

To evaluate the efficacy or usefulness of the Emergenetics Profile, a post-workshop survey was administered to a randomly selected sample of individuals from June 2012 to June 2015. The survey was given to 359 individuals (F = 229, M = 130) and consisted of items that evaluated how they used their Profiles, how their organization viewed Emergenetics and the most appealing piece of Emergenetics.

Results demonstrated that:

1. When asked, "Since taking Emergenetics, I have used the results to..."
    - 79.3% of individuals said they gained a better understanding of themselves
    - 68.8% said they understood personal relationships better
    - 63.8% said they understood their team better
    - 29.3% said they understood their significant other better

2. When asked, "In my organization, Emergenetics is..."
    - 36% said Emergenetics is used across the organization
    - 27.6% said the Profile is used to help work with peers
    - 25.8% said that the language around the Profile is a common language we can all speak
    - 18.5% said their Profile is used by specific teams

3. When asked, "In your opinion, what is the most appealing part of Emergenetics..."
    - 14.5% said its applicability in the workplace
    - 11.6% said it's simple interpretation
    - 7.2% said its visual display
    - 59.8% said the most appealing part was all of the above

The results from this post-workshop survey suggest participants understand and use Emergenetics to:

- Improve job performance and communication
- Understand basic preferences for thinking and behavior within a work environment
- Illustrate how personal preferences can be perceived as either strengths or an opportunity to improve
- Understand how personal preferences may affect others
- Build a collaborative organizational workforce
- Engage in meaningful dialogue and information about the way individuals approach work activities

As stated earlier, it is important to note that the Emergenetics Profile is a norm-based comparative tool, ***NOT*** a diagnostic analysis of personality type. The normative scoring of preferences helps people compare the intensity of their own personal preferences to those of other people. There is not a best or worst Profile, only Profiles that provide individuals with enough knowledge to understand how their preferences facilitate, or conversely, interfere with what they attempt to achieve. Scores are re-normed biannually and adjusted to reflect the latest two years of global data.

What does all this mean?
Overall, individuals who attended a workshop and received an Emergenetics Profile found it useful for better understanding themselves and improved workplace collaboration. This highlights the usefulness of the Emergenetics Profile in not only better understanding oneself but also improving interpersonal interactions.

Reliability

Reliability is a statistical test that evaluates the consistency of scores. This applies to both the consistency of the factors themselves or how the items that make up a factor are related (e.g., inter-item reliability) and whether factor scores are consistent over time (e.g., test-retest reliability).

Inter-Item Reliability

Inter-item reliability is a measure of how well individual item scores correlate with the overall factor score. We used the gold standard of Cronbach's Coefficient-Alpha to evaluate the reliability of each factor in the Emergenetics survey. Cronbach's Alpha refers to the average of all possible inter-item and split-half correlations, both strong and weak. Importantly, it does not rely on a single indicator of reliability which may contain large amounts of error.[23,24]

The inter-item reliabilities of the Emergenetics Profile (N = 89,101) ranged from $\alpha = .71$ to $\alpha = .83$, with 8-11 items in each factor.

Inter-Item Reliability

Emergenetics Factor	**Coefficient Alpha**
Analytical	0.83
Structural	0.71
Social	0.76
Conceptual	0.76
Expressiveness	0.78
Assertiveness	0.78
Flexibility	0.79

What does all this mean?
Each of the seven Attributes demonstrates good inter-item reliability such that the items that make up each factor are highly related to one another, and individuals answer these items consistently. We know this because the alpha values are all above 0.70, the gold standard to reliability.

Test-Retest Reliability

Test-retest reliability refers to the stability of the survey over time. In other words, whether survey scores remain the same if the test is taken more than once by the same person.

To understand if Emergenetics has good test-retest reliability, we conducted a study that included 307 participants (Female = 191; Male = 117). The participants completed their first Profiles in late 1993; we then followed up with them ten years later, in 2003, to take the same survey again. Next, we conducted two analyses.

1. To compare the 1993 results to the 2003 results, we first examined bivariate correlations, which revealed that the scores from 1993 and 2003 were highly related to one another (correlations ranged from $r = .68$ and $r = .77$).

2. After conducting correlations, we then ran a paired samples t-test to examine if the scores from 1993 were statistically different from the scores in 2003. Overall, we found that five of the seven factors showed no statistically significant difference in scores.
    - Importantly, Analytical, Social, Expressiveness, Assertiveness, and Flexibility did not show significant change from 1993 to 2003.
    - Structural was one of the factors that did show a significant change from 1993 to 2003, though when we examine the two mean scores; we see a negligible difference (40.51 in 1993 compared to 38.17 in 2003). Thus, although significant, this difference is highly unlikely to yield practical or actionable differences.
    - Conceptual was the only other factor to show a significant change from 54.37 in 1993 to 61.91 in 2003. This may have been impacted by the societal trends in the industry. It is likely that this increase in Conceptual scores is due to the "workshop-effect" or the phenomenon where participating in the workshop activities encourages creativity.

Paired T-Test Results of 1993 Scores Versus 2003

The Emergenetics factors	Mean difference	t-value	p-value
Analytical (1993) vs. Analytical (2003)	1.52	1.49	0.14
Structural (1993) vs. Structural (2003)	2.44	2.33	0.02
Social (1993) vs. Social (2003)	-1.90	-1.86	0.64
Conceptual (1993) vs. Conceptual (2003)	-7.53	-7.39	<0.001
Expressiveness (1993) vs. Expressiveness (2003)	0.61	0.62	0.53
Assertiveness (1993) vs. Assertiveness (2003)	1.76	1.63	0.10
Flexibility (1993) vs. Flexibility (2003)	-0.67	-0.62	0.54

What does all this mean?
The Emergenetics tool is highly stable with good test-retest reliability. Someone could take the survey again in 10 years and would likely get similar results. We know this because we had a group of 307 adults take the survey in 1993 and then again in 2003 and as a group, they had very similar results.

Validity

Evaluating the validity means evaluating whether the test measures what it is intended to measure. There are many different measures of validity, including:

- Face validity
- Convergent/Discriminate validity
- Predictive and concurrent criterion validity
- Construct validity
- Content validity

Since the Emergenetics Profile is a normative nomological instrument, we limit our evaluation of validity to face validity, convergent/discriminate validity, and construct validity.

Face Validity

Face validity refers to how effective a survey or test appears to be in terms of its stated aims. The Emergenetics Profile aims to capture everyday behaviors and ways of thinking that people may engage in.

To evaluate face validity, we randomly sampled 412 individuals (M = 182, F = 230) and asked them, "To what degree do you feel the items included in the Emergenetics questionnaire reflect everyday behaviors and preferences?" They rated this on a scale from 1 – strongly disagree to 5 – strongly agree.

We found that 73% of individuals either strongly agreed or agreed, 23.3% were neutral, and less than 4% disagreed or strongly disagreed.

These results suggest the thinking and behavioral items are, on their face, valid or representative of everyday behaviors.

Face Validity

	Frequency	Percent
1 – Strongly disagree	2	0.5%
2 – Disagree	13	3.2%
3 – Neither agree nor disagree	96	23.3%
4 – Agree	246	59.7%
5 – Strongly agree	55	13.3%

What does all this mean?
The Emergenetics Profile effectively captures everyday behaviors and ways of thinking. We know this because we had 412 individuals rate whether or not they agreed that items in the survey reflected everyday behaviors or ways of thinking and the majority (73%) either agreed or strongly agreed.

Nomological Convergent/Discriminate Validity

Convergent and discriminate validity evaluate the validity of the Emergenetics Profile in two ways:

1. This analysis examines relationships between factors by examining both convergent (agreement) and discriminant (non-agreement) correlations within the instrument.
    - This evaluates the validity of the factors within the Emergenetics Profile.
2. The analysis examines the relationship between scores on the survey and an independent measure of the same factors.
    - This evaluates the validity of the factors compared to an independent third party.[25]

It should be noted that behaviors are seldom "pure" or orthogonal; rather, there is often overlap between behaviors such that they share characteristics but are used to meet different goals. In other words, macro-level descriptions of behavior can cause factor scores to share interdependence or be related to one another. For example, social assertiveness (i.e., Expressiveness) and task assertiveness (i.e., Assertiveness) both contain items that are related to the Attribute of Assertiveness even though their goals may be entirely different (e.g., stand out socially vs. accomplish tasks).

Given this overlap, many other instruments imply that once you know an individual's thinking preferences, you can use that same information to accurately predict their behaviors. For example, if you are Analytical, it is often assumed you must also be quiet and thoughtful. We have found these assumptions to be problematic.

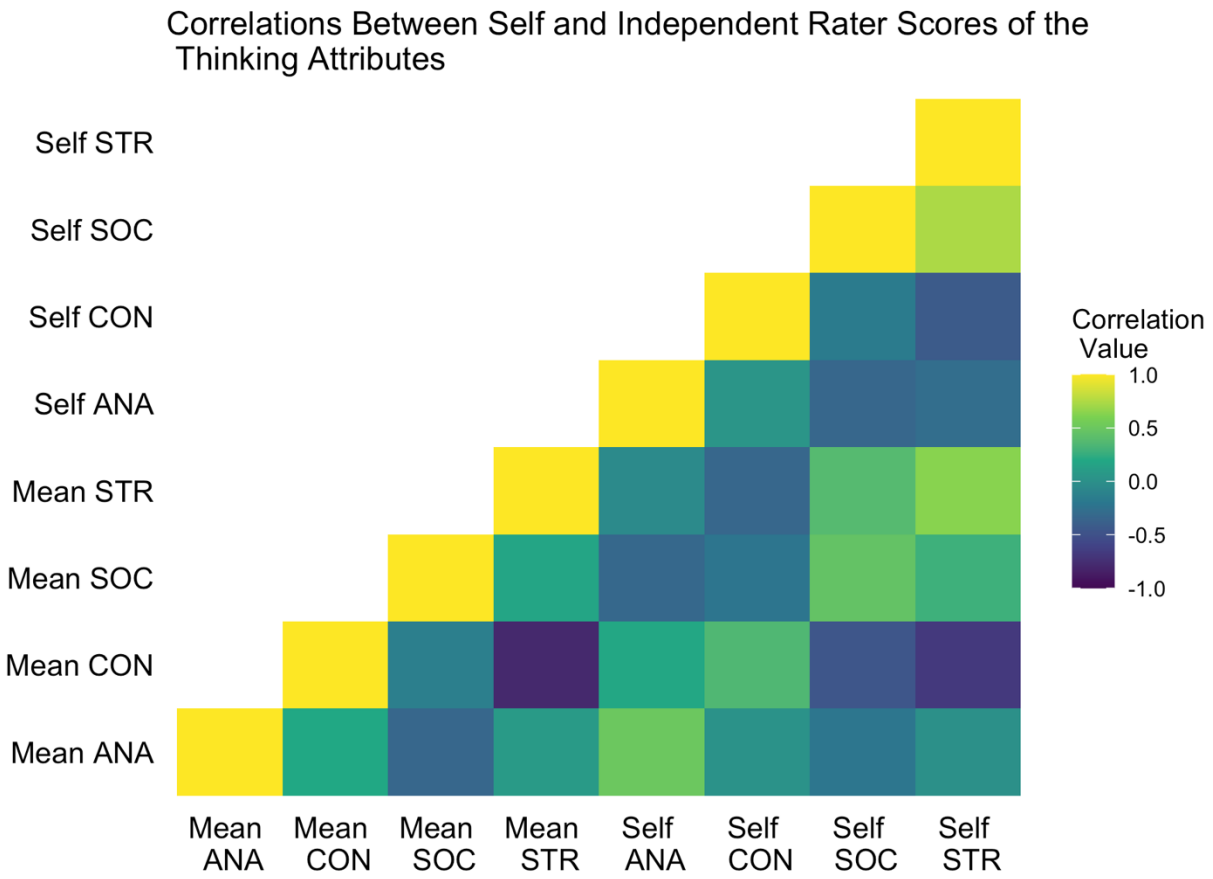
In order to separate out behaviors and thinking preferences that have different goals, the Emergenetics Profile has been designed with two complementary sections:

1. How a person prefers to think and process information (i.e., thinking preferences)
2. How a person acts out these preferences with others. (i.e., behavior preferences)

As we noted earlier, personality factors or behaviors are not always orthogonal (i.e., do not overlap); rather, some behaviors may covary (i.e., have overlap) with others. Therefore, some correlations between behaviors and thinking preferences are higher than we would like. Nevertheless, we have included these factors because, in our experience, they help individuals better understand why observing someone's behavior is insufficient to predict their thinking preferences; and, likewise, why someone's thinking preferences provide insufficient data to predict their behavior.

Within Attribute & Independent Rater Correlations

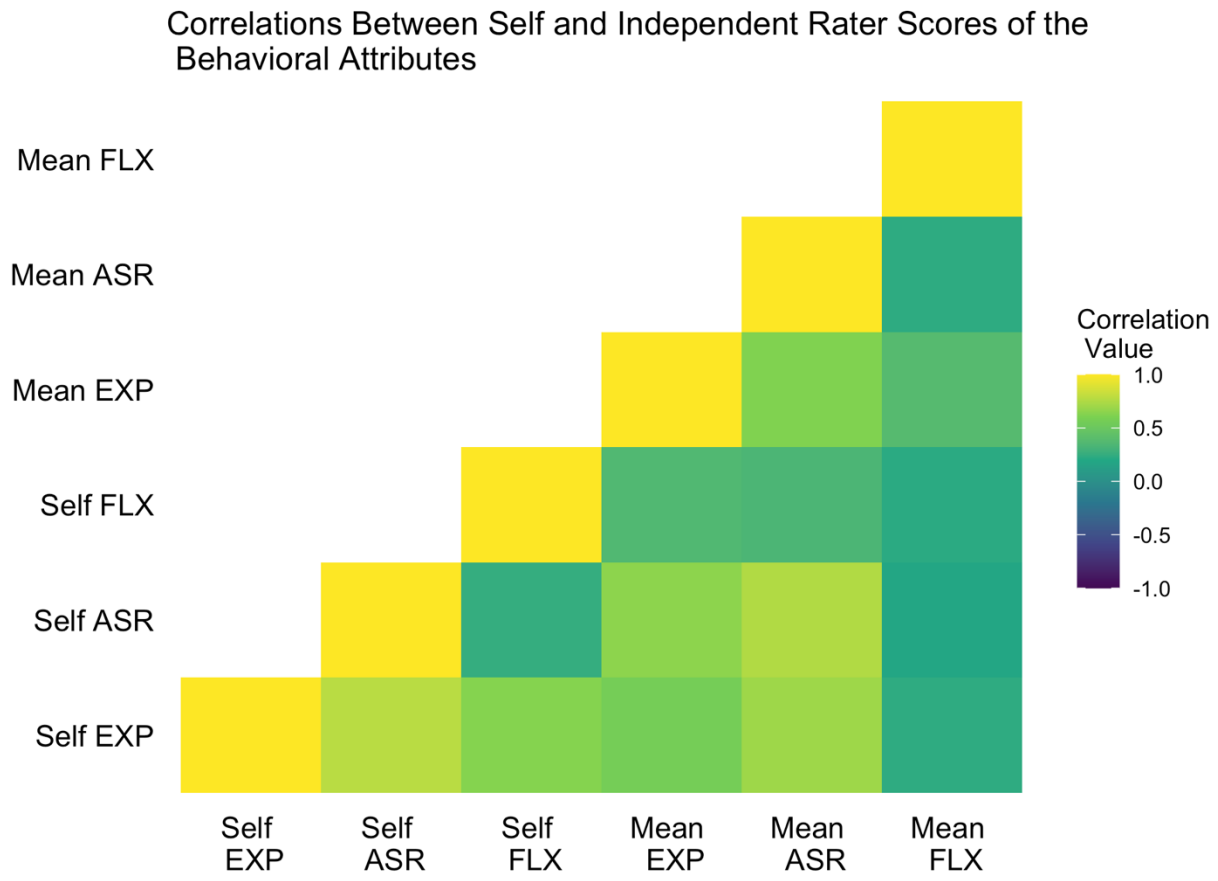
The following tables represent a multi-trait multi-matrix network showing the correlations between the subject's responses, as a percentile score, for each factor. Additionally, the graphs below show the correlations between the mean-score ratings from independent observers and Attribute percentiles.
(Note: For accessibility the following tables and graphs use a color-blind friendly palette.)



The above graph shows the Pearson's correlation values (*r*) for each of the self-reported percentile scores and independent rater scores for a random sample of 50 individuals. In the graph, correlations closer to *r* = -1.0 are represented by darker blues and purples, and as correlations move towards 0, they become greener, shifting to yellow as they get closer to *r* = 1.0. Correlations closer to 1.0 and -1.0 are the stronger (although in opposite directions), while correlations closer to 0 are the weaker.

Overall results demonstrate that self-reported scores converge positively with mean rater observation scores such that correlations between self-report and observer rating were:

- Analytical ($r = .504$, $p < .000$)
- Structural ($r = .352$, $p < .007$)
- Social ($r = .636$, $p < .004$)
- Conceptual ($r = .635$, $p < .000$)



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Overall results demonstrate that self-reported scores generally converge positively with mean rater observation scores such that correlations between self-report and observer rating were:

- Expressiveness ($r = .563$, $p < .003$)
- Assertiveness ($r = .752$, $p < .000$)
- Flexibility ($r = .221.$, $p < .134$)

Although self-reported Flexibility did not show a statistically significant correlation with observer-rated Flexibility, the *r*-value is greater than 0.20, thus indicating that there may be a small to medium positive relation present.

What does all this mean?

The Emergenetics Profile demonstrates good convergent/discriminate validity. We know this because self-reported scores and independent rater or observer scores are highly related such that they are aligned with one another. For example, if a person rated themselves as high in Structural thinking and an independent observer also rated them as high in Structural. We found similar relations for almost all other Attributes.

Contingency Analyses

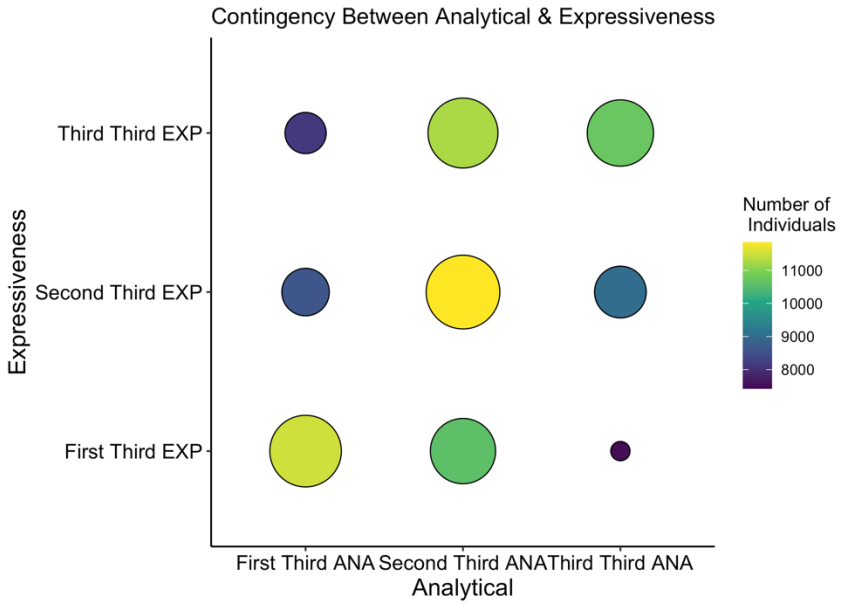
Researchers often use two techniques or statistical analyses to examine the relationship between two variables.

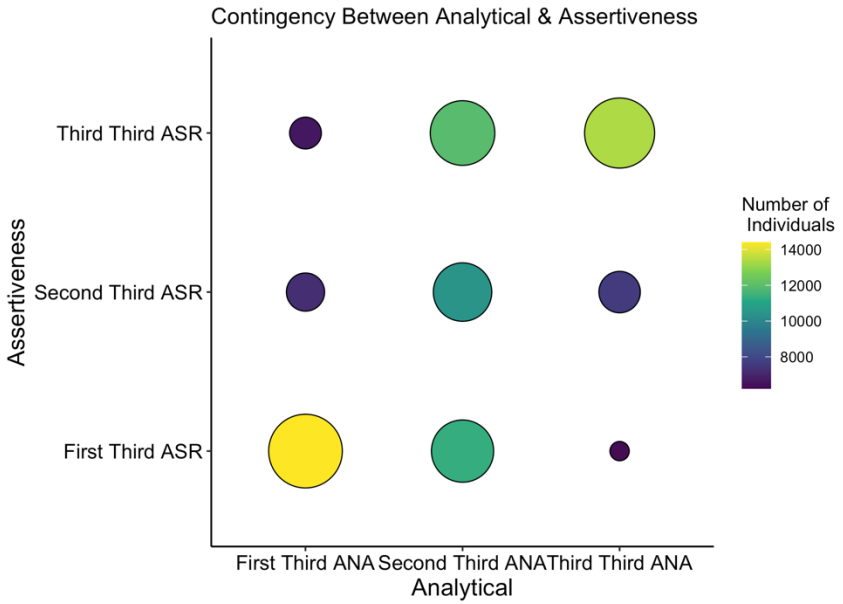
1. Correlation is one popular method to quantify how related or dependent a variable is with another variable. Mathematically, correlations are the process of fitting a line between two or more data points based on their mean and standard deviation.
    - For example, we can quantify the relationship between ice cream sales and shark attacks. ***Most importantly,*** correlations do not represent causal relationships. In other words, just because we find a correlation between ice cream sales and shark attacks ***DOES NOT*** mean that ice cream sales cause shark attacks.
    - Mathematically, we can break down a correlation such that a correlation of $r = 0.50$ simply tells us that a line can be drawn that minimizes the *plot distances* between roughly 25% of the data points (i.e., .5 squared). The remaining 75% of the data scatter is technically referred to as "unexplained variance."
2. Contingency analysis is another popular method used in survey research to understand the relation between two variables. Pearson suggested that when researchers find that variables are highly commingled, a contingency analysis would better quantify the relations between variables.[26]
    - For example, if we wanted to quantify how closely related paint colors on the same paint chip are, we would want to use contingency analysis. Paint colors on the same paint chips are highly similar to one another and therefore highly correlated, yet it is also sufficiently critical to quantify the differences as these differences may be critical when choosing a color.
    - Similar to correlation, relations quantified through contingency analysis ***DO NOT*** necessarily demonstrate causal relations.

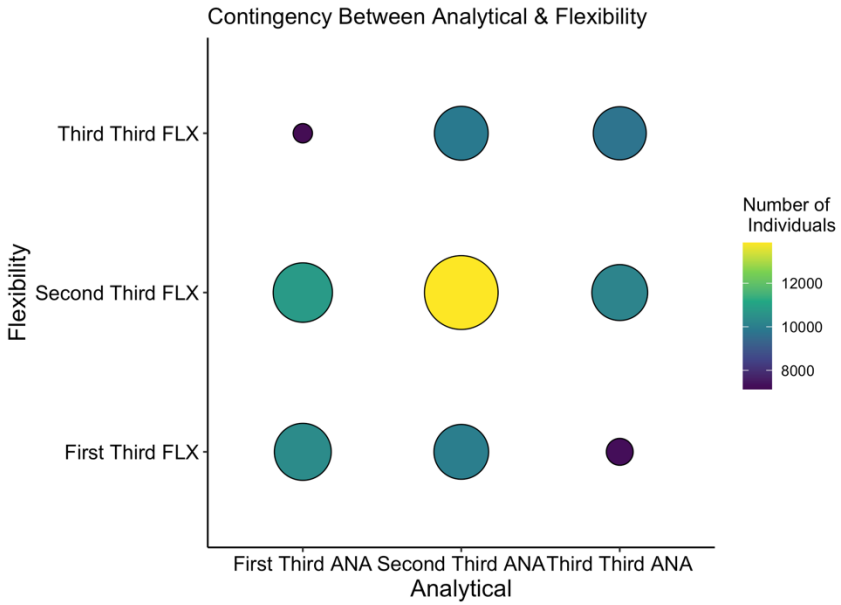
We used contingency analysis to explore differences in thinking preferences and behaviors. We believe that contingency analyses represent a better understanding of the nomological relationship between a thinking preference and a specific behavior because it allows for the exploration of small yet meaningful differences that may exist.

Using a randomly selected sample of 89,101 individuals, the below tables demonstrate contingencies for the Emergenetics thinking preferences and behaviors. To facilitate comparisons, we first *z*-scored the raw data to normalize and scale each factor, then divided each factor into bins of equal thirds based on percentiles.

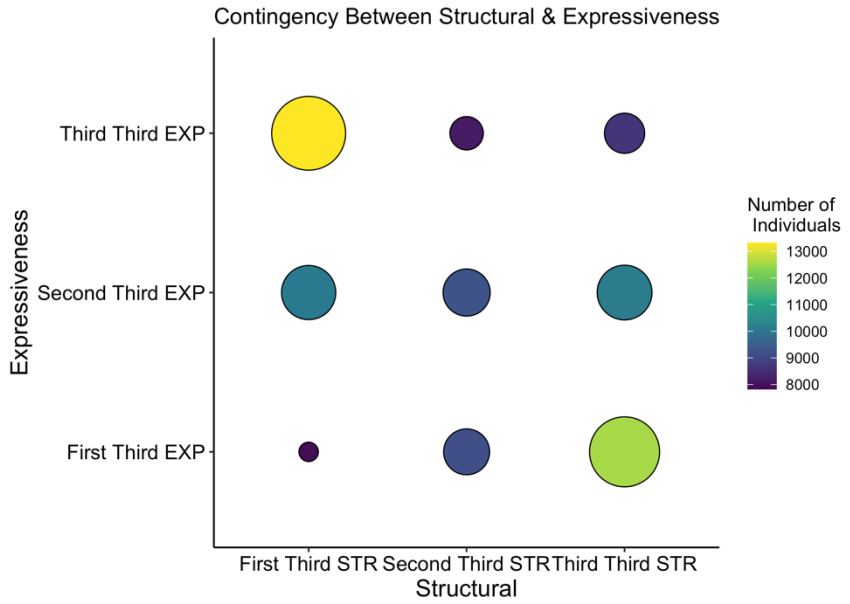
The contingencies reveal that while each of the factors may be related using correlations, there are, in fact, important differences between factors. For example, it may seem that Analytical thinkers may be more likely to fit a stereotypical behavior of peacekeeping, yet the contingency table reveals that those in the top third of Analytical thinking were more likely to rate themselves in the top third of Assertiveness as opposed to the bottom third. Overall, contingencies demonstrate the need for participants to hesitate to form conclusions about how people behave simply because they express a specific thinking preference.

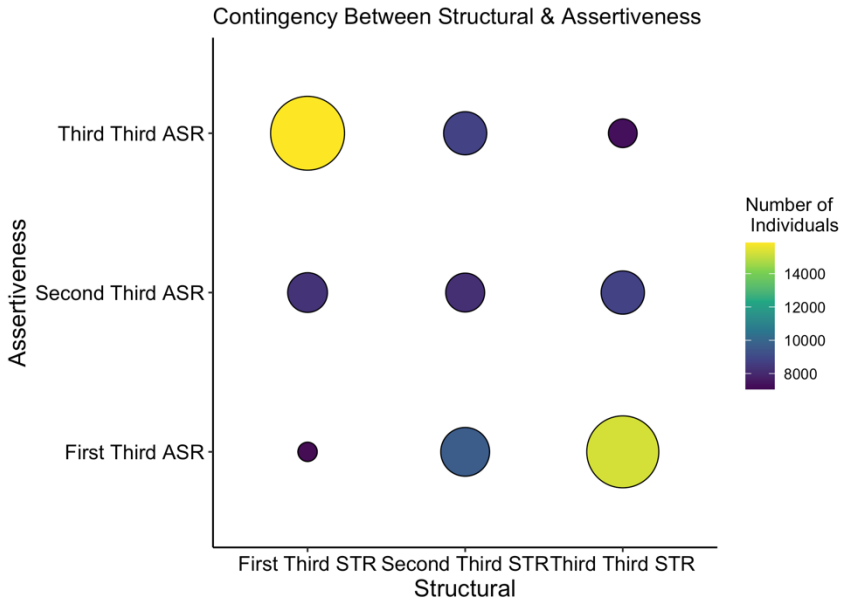


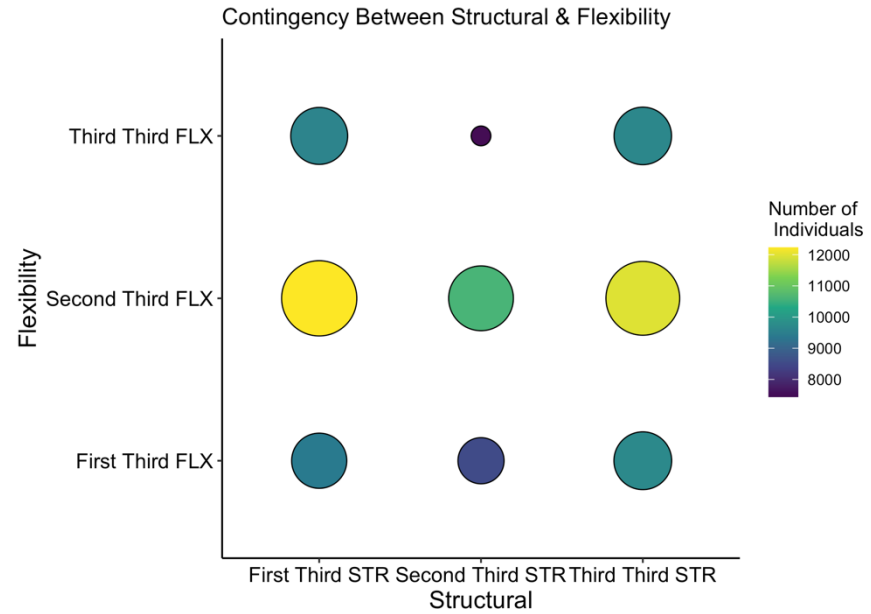




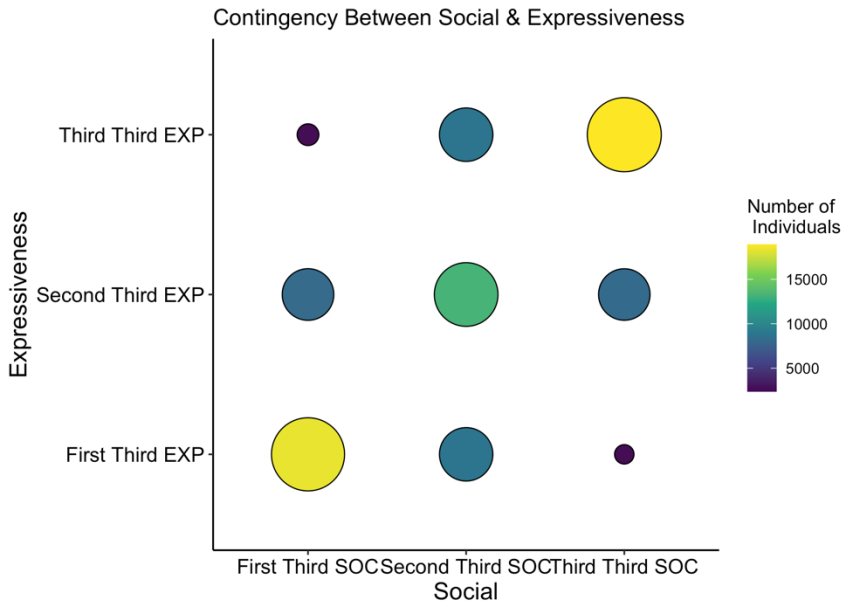
Each of these graphs shows the crosstabs between Analytical thinking and the three behavioral Attributes. The size and color correspond to how many individuals fall into that category, with larger circles indicating more individuals. Additionally, the more yellow a circle, the more individuals are contained in that category; as the color becomes greener and then blue, the number of individuals in that category decreases. For example, in the top right graph, we can see a medium green circle representing the number of individuals who are both third-third Analytical and third-third Expressive. Critically, we see that in each graph, there are individuals in all categories. Also, the size and color of the circles are randomly distributed throughout, such that there are no significant patterns.

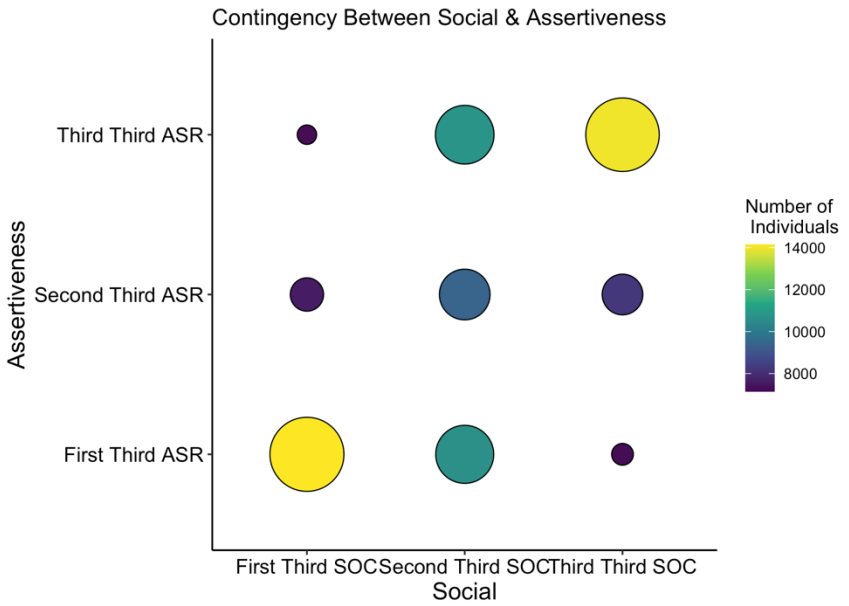


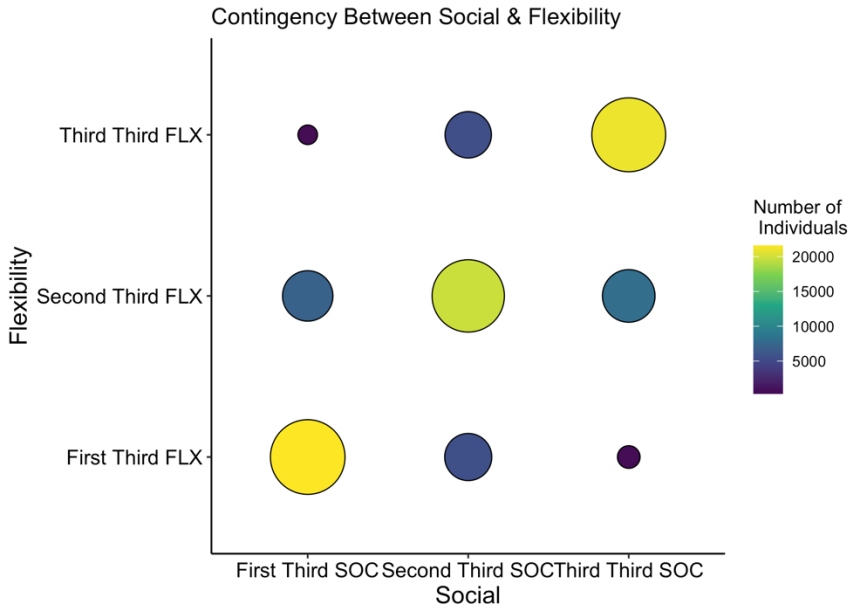




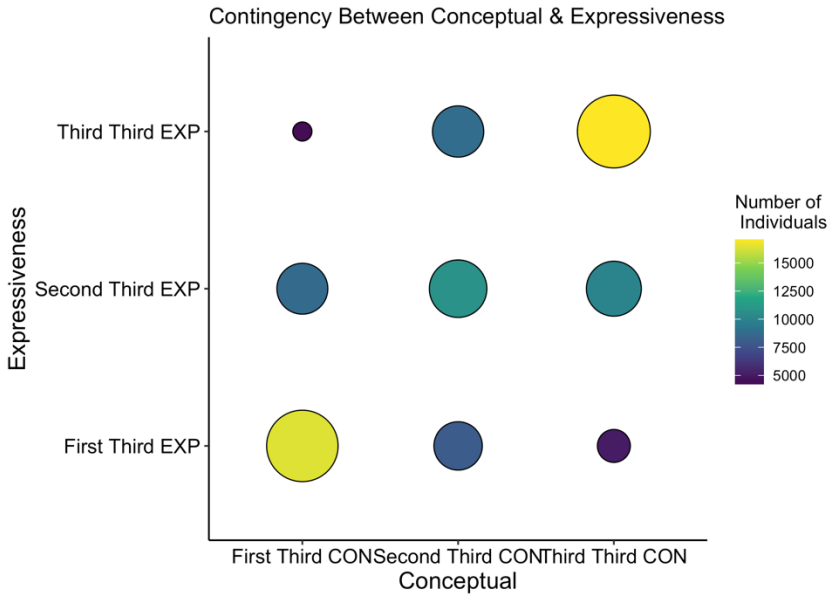
Each of these graphs shows the crosstabs between Structural thinking and the three behavioral Attributes. The size and color correspond to how many individuals fall into that category, with larger circles indicating more individuals. Additionally, the more yellow a circle, the more individuals are contained in that category; as the color becomes greener and then blue, the number of individuals in that category decreases. For example, in the top left graph, we can see a large yellow circle representing the number of individuals who are third-third Expressive and first-third Structural. Critically, we see that in each graph, there are individuals in all categories. Also, the size and color of the circles are randomly distributed throughout, such that there are no significant patterns.

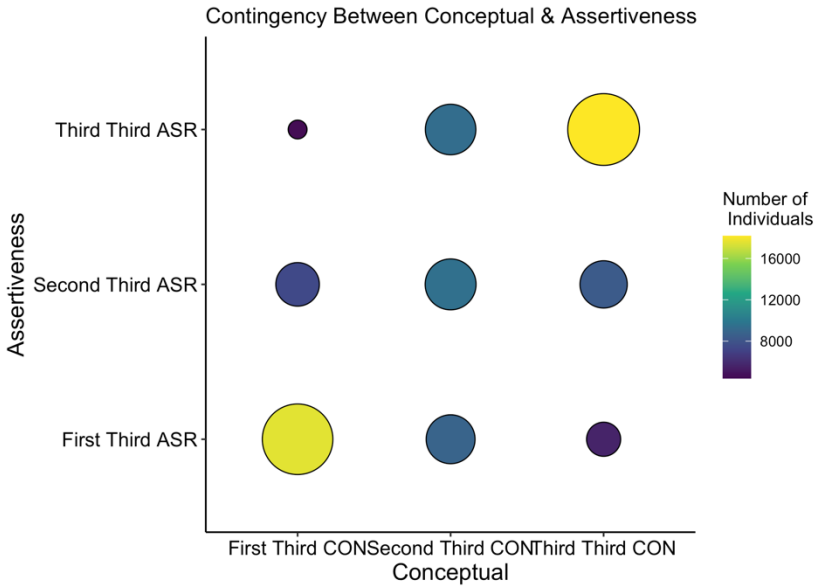


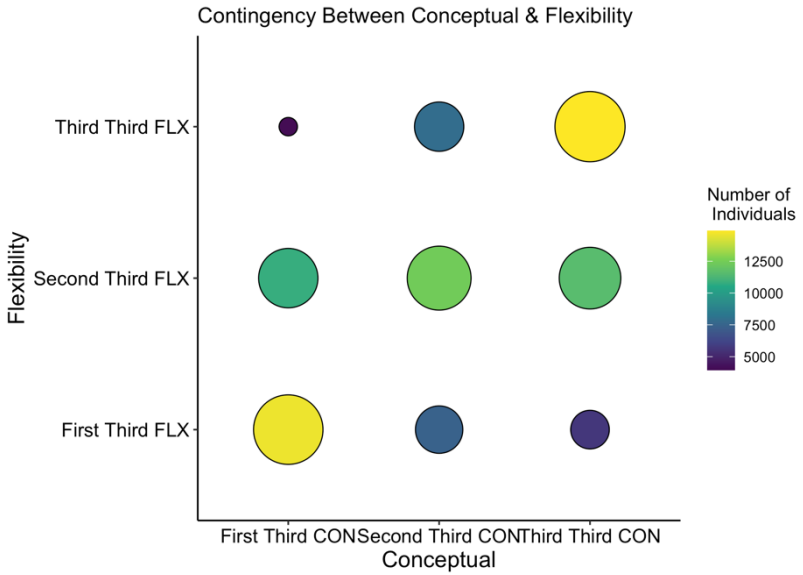




Each of these graphs shows the crosstabs between Social thinking and the three behavioral Attributes. The size and color correspond to how many individuals fall into that category, with larger circles indicating more individuals. Additionally, the more yellow a circle, the more individuals are contained in that category; as the color becomes greener and then blue, the number of individuals in that category decreases. For example, in the top right graph, we can see a large yellow circle representing the number of individuals who are both first-third Assertive and first-third Social. Critically, we see that in each graph, there are individuals in all categories. Also, the size and color of the circles are randomly distributed throughout, such that there are no significant patterns.







Each of these graphs shows the crosstabs between Conceptual thinking and the three behavioral Attributes. The size and color correspond to how many individuals fall into that category, with larger circles indicating more individuals. Additionally, the more yellow a circle, the more individuals are contained in that category; as the color becomes greener and then blue, the number of individuals in that category decreases. For example, in the bottom left graph, we can see a that there are many green and yellow circles representing the number of individuals who are in each pairing. Critically, we see that in each graph, there are individuals in all categories. Also, the size and color of the circles are randomly distributed throughout, such that there are no significant patterns.

What does all this mean?

The results of these contingency analyses demonstrate that only knowing an individual's thinking preferences does not guarantee that you can predict their behavioral preferences or vice versa. We know this because in each of these graphs we see a variety of circle sizes in all position rather than a diagonal line of large circles.

Construct Validity: Comparison to the NEO-PI

Construct validity refers to the ability of a survey or measurement tool to measure the concept it claims to measure. For example, if a survey claims to measure emotion regulation, construct validity would represent the ability of the survey to measure emotion regulation. Often when analyzing the construct validity of a survey, researchers will compare the new survey to another established survey as validation that the new survey is, in fact, measuring the concept it claims to be measuring.

To evaluate the construct validity of the Emergenetics Profile, the seven thinking and behavioral Attributes were compared to the NEO-PI. The NEO-PI is a comprehensive assessment of the Big Five model published by Psychological Assessment Resources, Inc.

The NEO-PI FFM

The NEO-PI was developed by Paul Costa and Robert McCrae[4] based on personality research conducted in the 1950s, showing that virtually all *language-based* personality traits tend to cluster into roughly 20 sub-groups, which in turn cluster into five meta factors.

1. Neuroticism (N): a compound score indicating the tendency to experience negative emotions such as fear, sadness, anger, disgust, embarrassment, and guilt
2. Expressiveness (E): a compound score indicating preferences for liking people, being around large groups, being assertive and talkative, upbeat, energetic, and active
3. Openness (O): a compound score indicating active imagination, aesthetic sensitivity, inner feelings, variety, curiosity, and independence
4. Agreeableness (A): a compound score indicating sympathy and eagerness to help
5. Conscientiousness (C): a compound score indicating strong will, self-control, planning, organizing, purposefulness, and achievement

Nomological Criticism of the NEO-PI FFM

Examining the NEO-PI factors, it is easy to see that personality analysis based on language can be complex. For one thing, in the real world, personality interactions rarely occur as a single word. They often occur as components of observable behaviors that vary with emotional state and situation (e.g., someone who is socially warm may concurrently be gregarious and forceful). Thus, researchers using person-descriptive sentences have concluded that although an FFM may be an interesting biologically-based human universal that generalizes across culture, language, gender, and type of assessment rating source; its analytical clustering technique has generated a considerable number of questions about whether it should be used as a universal taxonomy for predicting actual behavior.

For example, while the conscientiousness factor may appear to be homogenous, it can be argued that it is a combination of multiple discrete behavioral descriptions (e.g., occupational competence, capability, sensibility, prudence, effectiveness, being orderly, tidy, well organized, planful, being dutiful, ethical, conscientious, having moral obligations, achievement-oriented, aspirational, diligent, and driven). Thus, although the conscientiousness factor is generally recognized as a strong predictor of job performance, its multiple traits make practical application as a personality construct problematic.

Correlations Between the Emergenetics Nomological Factors and NEO-PI Lexical Personality Traits

Given the NEO-PI covers the entire personality domain and is based on a granular analysis of the human lexicon (as opposed to Emergenetics' seven nomological observations), we expect Emergenetics' nomological constructs to correlate across several FFM lexical factors.

To compare the NEO-PI's lexical constructs with the Emergenetics nomological constructs, we used Stepwise regression analysis. We specifically compared the seven Emergenetics factors (listed below) with the factors and sub-groups of the NEO-PI (listed above). Emergenetics Profile percentiles were chosen as the independent variables. NEO-PI scores converted using *z*-score transformations were chosen as the dependent variables.

The Emergenetics (EP) Attributes include:

1. Analytical (ANA): having an interest in problem-solving, understanding complex subjects, and mental analysis
2. Structural (STR): prefers rules and regulations, stability, hands-on approach, and avoiding risk
3. Social (SOC): intuitive about people, social concerns, working in teams, seeks approval from others
4. Conceptual (CON): intuitive about ideas, seeks unique activities, experimentation, futuristic
5. Expressiveness (EXP): based on a continuum from calm and introspective to talkative and gregarious
6. Assertiveness (ASR): based on a continuum from calm and peacekeeping to forceful and driven
7. Flexibility (FLX): based on a continuum from deciding easily to being open to revisions

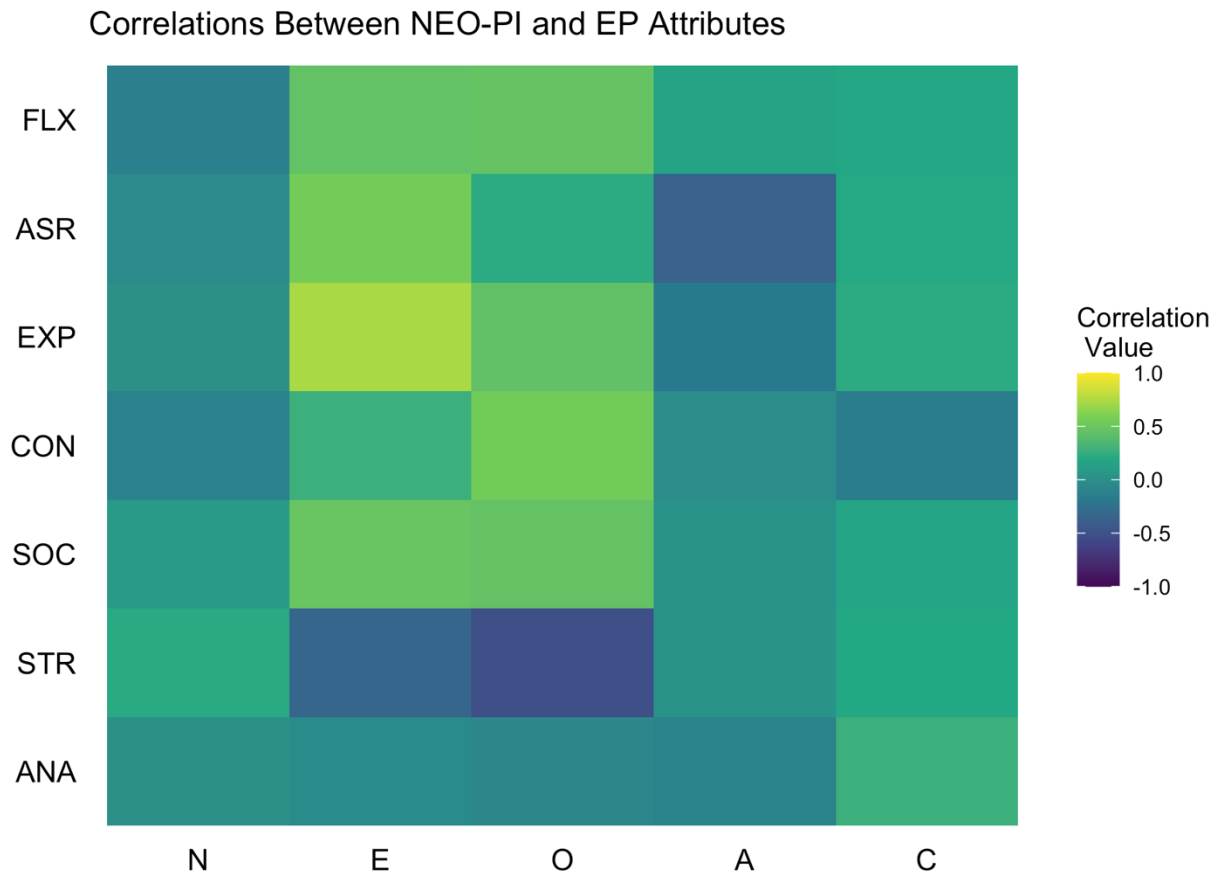
Emergenetics vs. NEO-PI Meta Factors

The next table shows the seven Emergenetics nomological factors correlated with the FFM trait meta-factors. As shown, there are statistically significant relationships between all Emergenetics nomological factors and most of the FFM lexical factors. This suggests the seven Emergenetics nomological factors correlate with but may be less complex and, most importantly, more practical than lexical theory.

Correlation Matrix of NEO-PI Meta Factors & EP Attributes

	ANA	STR	SOC	CON	EXP	ASR	FLX
N	0.003	**0.218***	0.088	-0.118	0.006	-0.049	-0.137
E	-0.032	**-0.342***	**0.486*****	**0.269****	**0.731*****	**0.554*****	**0.457*****
O	-0.077	**-0.517*****	**0.459*****	**0.547*****	**0.446*****	**0.223***	**0.471*****
A	-0.105	0.029	0.028	-0.027	-0.195	**-0.365*****	0.170
C	**0.271***	0.201*	0.178	-0.167	0.225*	0.203*	0.192

Note: * = $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$



The above graph shows the Pearson's correlation values (*r*) for each of the EP attributes and NEO-PI meta factors. In the graph, correlation closer to *r* = -1.0 are represented by darker blues and purples, and as correlation move towards 0, they become more green, shifting to yellow as they get closer to *r* = 1.0.

What does all this mean?

The Emergenetics Profile demonstrates good construct validity. We know this because when we examined how the Attributes are related to the NEO-PI meta factors, we generally found strong positive relations. These relations demonstrate that the EP factors are likely measuring the everyday behaviors that it claims to be measuring. Where we see differences between the NEO-PI and EP Attributes these may represent where the Attributes are more sensitive to individual variation in these behaviors. This is critical because Emergenetics allows individuals to express all thinking styles and behaviors rather than constraining individuals, thus differences between the NEO-PI and EP may emerge. It should be noted that this allowance for variation is a strength of Emergenetics as individuals may vary their thinking and behavior based on the context of the situation or environment.

Independent Rater Validity

In addition to comparisons with other surveys, independent raters may be used to assess validity. This independent rater validity is critical as individual preferences should not only be self-evident but observable by independent third parties.

To investigate this validity, we calculated correlations between self-reported data and independent observers for 83 individuals or targets. These target individuals had previously completed the Emergenetics survey and were then asked to identify between 2-11 independent raters who knew them well and could complete a survey about their thinking preferences and behaviors. Each of the independent raters was given short descriptions of the seven Emergenetics factors and asked to rate the thinking and behaving Attributes using a 1-7 Likert scale.

Independent rater scores were first examined for inter-rater consistency, and individual ratings exceeding one standard deviation from the mean were eliminated on an item-by-item basis to minimize outliers.

Overall, using Multi-Trait-Multi-Method analysis results demonstrated the seven Emergenetics factors are easily recognized by independent raters.

* Note: Targets with less than three independent raters were excluded from the final analysis

Independent Rater Correlations

Emergenetics Factor	**Pearson Correlation**
Analytical	0.50***
Structural	0.35**
Social	0.46**
Conceptual	0.63***
Expressiveness	0.56**
Assertiveness	0.75***
Flexibility	0.22

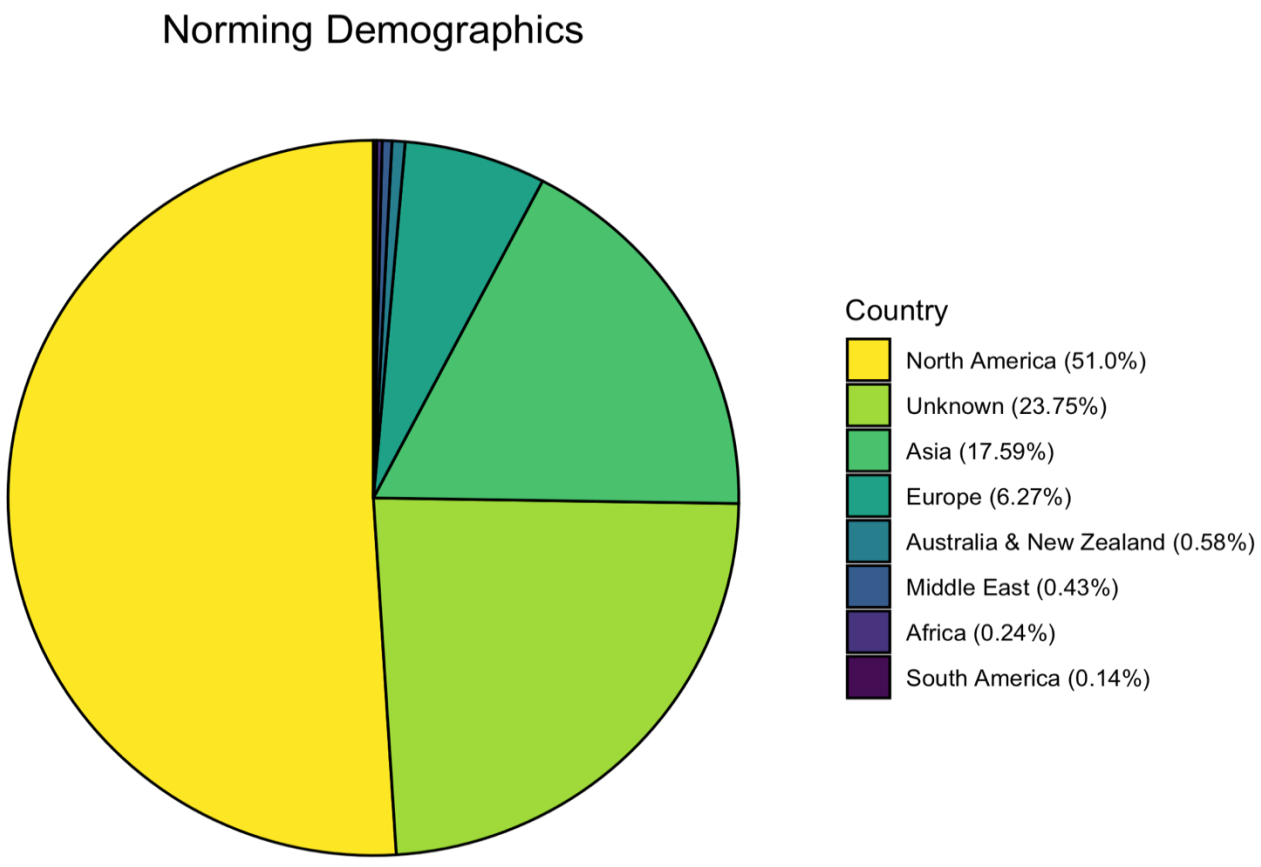
Note: * = $p < 0.05$, ** = $p < 0.01$, *** = $p < 0.001$., N = 27-50

What does all this mean?
The Emergenetics Profile demonstrates good independent rater reliability. We know this because we had 83 individuals identify independent raters to rate the target individuals on all seven Attributes. We then compared how individuals rated themselves to how these independent raters rated them. We found that in general the independent rates and self-reports were highly consistent. For example, if someone rated themselves as high in an Attribute, so did the independent rater.

Norming

Every two years, Emergenetics conducts a re-norming of our survey items. This process is a data-driven way to evaluate and ensure clarity for each of the seven Attributes. Importantly, the re-norming process allows us to account for how the manifestation of Attributes may change with societal changes. For example, the evolution of technology has significantly influenced how we interact with one another professionally and personally. In the last few years, we have seen transformations in the access and usability of technology. Broader access and ease of technology use have made it more efficient for most people to gain quick access to information. Historically access to this level of information was often limited to printed materials, television, or radio. However, with the internet, software, and devices, information can now be easily accessed in a variety of ways, from podcasts to video tutorials to blog posts. Instantaneous access to information via the internet and social media may influence how we interact with one another and quickly connects us globally. The broader implications of the technological changes may continue to influence and shape the way individuals may manifest their Attributes. Therefore, re-norming helps us to account for these changes and keeps our tool relevant, applicable, and useful for everyday use. The re-norming process was last completed in 2019. During the 2019 re-norming process, we evaluated response patterns to each item on the questionnaire. This evaluation resulted in ensuring the clean alignment of the items for each Attribute in order to strengthen our results and produce quality reports.

Our global norms include Profiles from seven different regions.



Conclusion

The Emergenetics Profile indicates how you prefer to think, learn, problem solve, and communicate through seven Attributes. The seven Attributes are integrated and taken wholistically to display an individual's unique ways of thinking and behaving. The development of the Emergenetics Profile is supported by Emergenetics theory, which proposes humans have a combination of genetic tendencies to think and act in certain ways that have been influenced through socialization (Browning, 2007). Overall, the data suggests the Emergenetics nomological approach to personality differences cuts across multiple lexical personality theory factors; shows construct validity, convergent/discriminate validity, and independent observer validity. Critically, individuals report that Emergenetics has robust utility in real-world applications. The unique and novel separation of thought preferences and behaviors provides a simple way for all individuals to better understand interpersonal and intrapersonal differences in the way they may interact with the world.

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Appendix A: Tables

Paired Samples Descriptives

Pairs	**Mean**	**N**	**Std Dev**	**Std Error**
Analytical (1993)	51.52	307	25.39	1.45
Analytical (2003)	50.00	307	26.43	1.51
Structural (1993)	40.61	307	24.89	1.42
Structural (2003)	38.17	307	27.36	1.56
Social (1993)	46.49	307	24.11	1.38
Social (2003)	48.39	307	26.09	1.49
Conceptual (1993)	54.37	307	25.66	1.46
Conceptual (2003)	61.91	307	26.70	1.52
Expressiveness (1993)	53.85	307	24.75	1.41
Expressiveness (2003)	53.24	307	25.51	1.46
Assertiveness (1993)	57.94	307	23.69	1.35
Assertiveness (2003)	56.18	307	23.96	1.37
Flexibility (1993)	46.64	307	23.37	1.39
Flexibility (2003)	47.31	307	25.76	1.47

Paired Samples T-Test

The Emergenetics factors	Mean Difference	Std Deviation	Std Error Mean	T-Value	P-Value
Analytical (1993) vs. Analytical (2003)	1.52	17.95	1.03	1.49	0.14
Structural (1993) vs. Structural (2003)	2.44	18.33	1.05	2.33	0.02
Social (1993) vs. Social (2003)	-1.90	17.92	1.02	-1.86	0.64
Conceptual (1993) vs Conceptual (2003)	-7.53	17.88	1.02	-7.39	<0.001
Expressiveness (1993) vs. Expressiveness (2003)	0.61	17.06	0.97	0.62	0.53
Assertiveness (1993) vs. Assertiveness (2003)	1.76	18.94	1.08	1.63	0.10
Flexibility (1993) vs. Flexibility (2003)	-0.67	18.83		-0.62	0.54

Validity

Self Reported Thinking Preferences vs. Independent Rater Observations

	Self ANA	Self STR	Self SOC	Self CON	Mean ANA	Mean STR	Mean SOC
Self STR	0.20						
Self SOC	-0.33*	-0.14					
Self CON	0.09	-0.80***	0.17				
Mean ANA	0.50***	0.19	-0.33*	-0.05			
Mean STR	0.02	0.35*	-0.22	-0.33*	0.04		
Mean SOC	-0.22	-0.46**	0.46**	0.38*	-0.33*	-0.17	
Mean CON	0.002	-0.67***	0.29***	0.64***	-0.28	-0.43*	0.74***

* $p < 0.05$, ** $p < 0.005$, *** $p < 0.001$

Self Reported Behavioral Preferences vs. Independent Rater Observations

	Self EXP	Self ASR	Self FLX	Mean EXP	Mean ASR
Self ASR	0.78***				
Self FLX	0.63***	0.25*			
Mean EXP	0.56**	0.65***	0.36*		
Mean ASR	0.70***	0.75***	0.33	0.61*	
Mean FLX	0.23	0.18	0.22	0.39	0.23

* $p < 0.05$, ** $p < 0.005$, *** $p < 0.001$

Contingency Analyses

Cross Tabulations of Analytical and Expressivness Preferences

	EXP First-Third	***EXP Second-Third***	***EXP Third-Third***	Total
ANA First-Third	*11508 (40.7%)*	*8612 (30.5%)*	*8141 (28.8%)*	28261
ANA Second-Third	*10584 (31.4%)*	*11845 (35.2%)*	*11260 (33.4%)*	33689
ANA Third-Third	*7424 (27.3%)*	*8997 (33.1%)*	*10730 (39.5%)*	27151
Total	29516	29454	30131	89101

Cross Tabulations of Analytical and Assertiveness Preferences

	ASR First-Third	***ASR Second-Third***	***ASR Third-Third***	Total
ANA First-Third	14403 (51.0%)	7207 (25.5%)	6651 (23.5%)	28261
ANA Second-Third	1132 (33.6%)	10458 (31.0%)	11908 (35.3%)	33689
ANA Third-Third	6221 (22.9%)	7575 (27.9%)	13355 (49.2%)	26151
Total	31947	25240	31914	89101

Cross Tabulations of Analytical and Flexibility Preferences

	FLX First-Third	***FLX Second-Third***	***FLX Third-Third***	Total
ANA First-Third	10353 (36.6%)	10777 (38.1%)	7131 (25.2%)	28261
ANA Second-Third	9989(29.7%)	13859 (41.1%)	9841 (29.2%)	33689
ANA Third-Third	7261 (26.7%)	10170 (37.5%)	9720 (35.8%)	27151
Total	27603	34806	26692	89101

Cross Tabulations of Social and Expressivness Preferences

	EXP First-Third	***EXP Second-Third***	***EXP Third-Third***	Total
SOC First-Third	18350 (63.5%)	8133 (28.2%)	2408 (8.3%)	28891
SOC Second-Third	8788 (28.5%)	13238 (42.9%)	8812 (28.6%)	30838
SOC Third-Third	2378 (8.1%)	8083 (27.5%)	18911 (64.4%)	29372
Total	29516 (33.1%)	29454 (33.1%)	30131 (33.8%)	89101

Cross Tabulations of Social and Assertiveness Preferences

	ASR First-Third	***ASR Second-Third***	***ASR Third-Third***	Total
SOC First-Third	14150 (49.0%)	7598 (26.3%)	7143 (24.7%)	28891
SOC Second-Third	10641 (34.5%)	9438 (30.6%)	10759 (34.9%)	30838
SOC Third-Third	7156 (24.4%)	8204 (27.9%)	14012 (47.7%)	29372
Total	31947 (35.9%)	25240 (28.3%)	31914 (35.8%)	89101

Cross Tabulations of Social and Flexibility Preferences

	FLX First-Third	***FLX Second-Third***	***FLX Third-Third***	Total
SOC First-Third	21587 (74.7%)	6993 (24.2%)	311 (1.1%)	28891
SOC Second-Third	5638 (18.3%)	19834 (64.3%)	5366 (17.4%)	30838
SOC Third-Third	378 (1.3%)	7979 (27.2%)	21015 (71.5%)	29372
Total	27603	34806	26692	89101

Cross Tabulations of Structural and Expressivness Preferences

	Exp First-Third	***Exp Second-Third***	***Exp Third-Third***	Total
STR First-Third	7821 (25.1%)	10067 (32.3%)	13324 (42.7%)	31212
STR Second-Third	9126 (34.4%)	9246 (34.8%)	8184 (30.8%)	26556
STR Third-Third	12569 (40.1%)	10141 (32.4%)	8623 (27.5%)	31333
Total	29516	29454	30131	89101

Cross Tabulations of Structural and Assertiveness Preferences

	Asr First-Third	***Asr Second-Third***	***Asr Third-Third***	Total
STR First-Third	7060 (22.6%)	8293 (26.6%)	15859 (50.8%)	31212
STR Second-Third	9628 (36.3%)	8193 (30.9%)	8735 (32.9%)	26556
STR Third-Third	15259 (48.7%)	8754 (27.9%)	7320 (23.4%)	31333
Total	31947	25240	31914	89101

Cross Tabulations of Structural and Flexibility Preferences

	Flx First-Third	***Flx Second-Third***	***Flx Third-Third***	Total
STR First-Third	9389 (30.1%)	12230 (39.2%)	9593 (30.7%)	31212
STR Second-Third	8523 (32.1%)	10594 (39.9%)	7439 (28.0%)	26556
STR Third-Third	9691 (30.9%)	11982 (38.2%)	9660 (30.8%)	31333
Total	27603	34806	26692	89101

Cross Tabulations of Conceptual and Expressivness Preferences

	Exp First-Third	***Exp Second-Third***	***Exp Third-Third***	Total
CON First-Third	16406 (55.9%)	8729 (29.7%)	4224 (14.4%)	29359
CON Second-Third	8034 (29.1%)	10784 (39.0%)	8826 (31.9%)	27644
CON Third-Third	5076 (15.8%)	9941 (31.0%)	17081 (53.2%)	32098
Total	29516	29454	30131	89101

Cross Tabulations of Conceptual and Assertiveness Preferences

	Asr First-Third	***Asr Second-Third***	***Asr Third-Third***	Total
CON First-Third	17562 (59.8%)	7405 (25.2%)	4392 (15.0%)	29359
CON Second-Third	8843 (32.0%)	9460 (34.2%)	9341 (33.8%)	27644
CON Third-Third	5542 (17.3%)	8375 (26.1%)	18181 (56.6%)	32098
Total	31947	25240	31914	89101

Cross Tabulations of Conceptual and Flexibility Preferences

	Flx First-Third	***Flx Second-Third***	***Flx Third-Third***	Total
CON First-Third	14608 (49.8%)	10807 (36.8%)	3944 (13.4%)	29359
CON Second-Third	7381 (26.7%)	12412 (44.9%)	7851 (28.4%)	27644
CON Third-Third	5614 (17.5%)	11587 (36.1%)	14897 (46.4%)	32098
Total	27603	34806	26692	89101

Construct Validity

Correlations between NEO-PII factors and all seven Attributes

	ANA	STR	SOC	CON	EXP	ASR	FLX
N	0.003	0.22*	0.088	-0.12	0.01	-0.05	-0.14
E	-0.03	-0.34**	0.49***	0.27*	0.73***	0.55***	0.46***
O	-0.08	-0.52***	0.46***	0.55***	0.45***	0.22*	0.47***
A	-0.11	0.03	0.03	-0.03	-0.20	-0.37***	0.17
C	0.27*	0.20*	0.18	-0.17	0.23*	0.20*	0.19

* $p < 0.05$, ** $p < 0.005$, *** $p < 0.001$

N = 97

Appendix B: Glossary of Terms

Construct validity: evidence that the test corresponds to other tests that measure the identified constructs

Content validity: evidence that the content of a test corresponds to the content of the construct it was designed to measure

Contingency analysis: a table representing the cross-classification of two or more categorical variables

Convergent validity: evidence that the test correlates with other measures of similar constructs

Discriminate validity: evidence that the test shows patterns of interrelationships with other variables

Face validity: evidence that the test items look like they measure the identified constructs

Inter-item reliability: evidence of consistency that items measure the same construct

Nomological: a representation of concepts or constructs of interest in a study, their observable manifestations, and their interrelationships

Reliability: the ability of a measure to produce consistent results when the same entities are measured under different conditions

Test-retest reliability: evidence that the results of a test will remain stable over time

Validity: evidence that a test measures what it was set out to measure conceptually