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In Pursuit of a Functional Personality Model

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Abstract: The personality of individuals defines their behavioral choices, but how exactly the personality traits are expressed remains uncertain, limiting our ability to create a computable model of a personality and predict behaviors. Here, we proposed a new functional personality model that is based on advances in modern neuroscience and defined by four parameters: 1) The hedonic values assigned to different "pleasant" aspects of behavioral outcomes (homeostatic balances, improved social status, et cetera); 2) The aversive values of "unpleasant" aspects (loss of sexual opportunity, potential of injury, loss of monetary reward, et cetera); 3) Summation parameters: discounting and dissolution parameters for simultaneously processed hedonic/aversive events; and 4) Threshold: the relationship between magnitude of predicted outcome and manifestation of behaviors. We expressed the idea through a mathematical formula, applied it, and at 0.90 power demonstrated that our model has an ability to estimate actual responses (Spearman's Rank-Order correlation = 0.5). Although more research and tuning are needed, we believe that our functional model may eventually allow accurate prediction of human behavior.

Keywords: neural integration; human decision making; behavioral informatics

Introduction

Consistently experienced thoughts, feelings, and behaviors are referred to as an individual's personality (Phares & Chaplin, 1997). The explanation of individual personalities relies upon understanding of the differences and similarities between people. These aspects have always been a central point of interest for philosophers, psychologists, and neuroscientists. Inheritable personality traits are evident in studies of twins and adoptions (Plomin, DeFries et al., 2008). These inheritable personality traits provide a potential mechanism to influence the psychology of human society through evolutionary selection, notably in domains such as cooperation and parenting (Buss, 2009; Buss, 2009).

Researchers disagree on which specific personality traits should be taken into consideration when attempting to model and predict human behavior. For example, the Big Five Model includes openness, conscientiousness, extraversion, agreeableness, and neuroticism traits (Ellis, Abrams et al., 2009). Marvin Zuckerman and his colleagues developed an alternative five-trait model of personality that includes sensation seeking, neuroticism–anxiety, aggression–hostility, sociability, and activity (Zuckerman, 1992). The psychobiological model of temperament and character proposes seven personality dimensions, including: novelty seeking, harm avoidance, reward dependence, persistence, self-directedness, cooperativeness, and self-transcendence (Cloninger 1987; Cloninger, Svrakic et al., 1993). The HEXACO personality model focuses on honesty-humility, emotionality, extraversion, agreeableness, conscientiousness, and openness to experience (Ashton & Lee, 2007). Some of these models are widely used for personality evaluations, but neuroscience evidence in their support typically remains limited (Comings, Gade-Andavolu et al., 2000; Terracciano, Balaci et al., 2009). For example, self-transcendence (spirituality) is a psychological concept that is not easily defined in biological terms. There is no known biological analog for honesty or humility, but rather a range of areas involved in emotion recognition, executive functions, computation of immediate and delayed rewards, and so on.

There are a number of attempts to mathematically model human behaviors and capture personality functioning within an individual. The recent attempts are focused on goals and motivational constructs (Emmons, 1991; Mischel & Shoda, 1995; Little, Salmela-Aro et al,. 2007). The neural network model proposed a way to link the personality structure and processes (Read, Monroe et al., 2013). None of these recent models has a clear link to the known structural organization of the central nervous system.

It is becoming an increasingly vital task to create a model of personality which is consistent with modern knowledge of brain organization and is computable. This approach may help to better understand personalities and personality disorders, predict a wide range of behavioral responses, and build a scaffold for artificial personalities.

Concept Description

The model proposed here is an attempt to explain our personalities and predict behaviors. The effort relies on the assumptions that the neurons and their connections are fully responsible for our personalities, and the decisions we make solely result from information processing in the biological substrate (see Read & Miller, 2014 for background on connectionist models of behavior). We follow the steps of our predecessors, in that we believe an unequal manifestation of personality traits makes us different, and the differences can be used to explain our specific behavioral choices. However, our choice of personality parameters is primarily rely upon modern experimental neuroscience findings. While many neurological findings are based on animal research, strong evidence for neurological basis of personality exists (DeYoung, Hirsh et al., 2010). Even though we do not specifically distinguish between personality states and traits (the focus is on overall prediction of behavior), our model allows one to describe the interactions between these parameters and behaviors that also can be expressed in mathematical calculations and tested in human studies (see Fig. 1). An advantage of this neurological based personality model over others is that this model allows prediction of observable behavior based on nervous system functionality.

Each individual at any given time has an established response to a stimulus, but the probability of this response is modified based on parameters of personality: Hedonic and Aversive Values, Summation, and Threshold. In response to a stimulus, a number of relevant hedonic and aversive values are triggered and assessed. Positive and negative values are discounted and balanced during the process of summation. A course of action is taken, if the positive or negative evaluation of the outcome is sufficiently strong (as defined by the threshold). If not, additional values may be taken into account. Without timely resolution, the process is weakened and ceases. Continuous interactions with the environment after response completion modify future processing of the stimulus (including scaling of values, reassigning the value relevance to a stimulus, as well as choices of new behavioral responses). The personality parameters as proposed by the model are discussed below in more detail.

Hedonic Values

In animals, the connection of an event to specific values is based largely on sensory associations, while in humans metacognition abilities and language-related associations are more important (Smith, Couchman et al., 2014). The evolution of association areas of the cortex clearly reflects these changes (Yeo, Krienen et al., 2011). The hedonic values reflect incentive salience ("wanting") (Schultz, 2002). Personalities are clearly distinct based on what is considered to be rewarding/motivating and by how much (Maslow & Frager, 1987). Some of these values are universal and innate (like food, drink, health), while others are gained through associative learning and conditioning (De Houwer, Thomas et al., 2001). Homeostatic needs and procreation are universal values across all species. The rapid evolution of values related to self-conception (expansion of boundary of self) puts humans apart from animals (Cloninger, Svrakic et al., 1993).

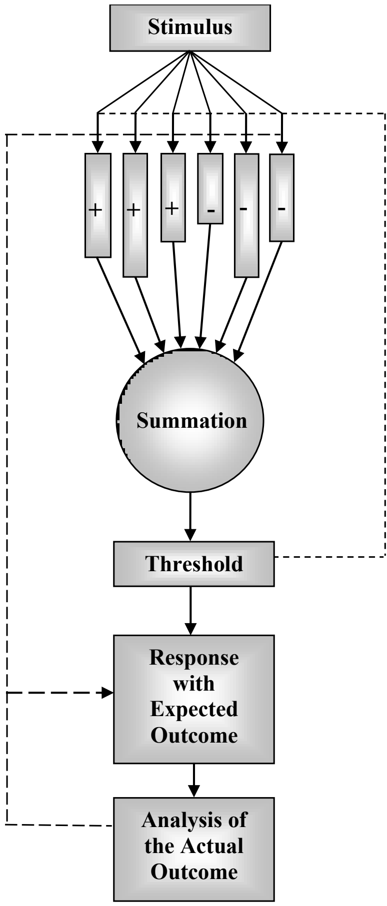

Figure 1. The functional personality model establishes the importance of personal values, parameters of their summation and of the threshold for behavioral choices.

Multiple brain regions are believed to be involved in the processing of different aspects of our personalities (Maddock, Garrett et al., 2001; Lieberman, Jarcho et al., 2004), including the prefrontal cortex and the posterior cingulate region in the medial posterior parietal cortex (Kelley, Macrae et al., 2002; D'Argembeau, Collette et al. 2005; Pfeifer, Lieberman et al., 2007; Brewer, Garrison et al., 2013). These areas have significant dopaminergic innervation from the ventral tegmentum area, which may serve as a substrate for a link between self-perception and reward processing (Carr & Sesack, 2000; Russo &Nestler, 2013).

Dopaminergic neurons of the ventral tegmentum area seem to be the most promising substrate for motivation and reward scaling. Both natural and artificial rewards are associated with an efflux of dopamine from the neurons of the ventral tegmentum area in the nucleus accumbens and striatum (Schultz, 1998). The neurotransmitter acts as a reinforcement to stimulate repetition of the behaviors that lead to its release in the first place (Luo & Huang, 2015). Not surprisingly, many theories of addiction propose a change in dopamine regulation following a drug's administration (Di Chiara, 1999). At the same time, it is increasingly clear, that dopamine's role in the brain is more complex and not limited to rewarding. For example, the neurotransmitter is released when enjoyable activity is only expected, and also released in response to some aversive stimuli (Lammel, Lim et al., 2014; Ikemoto, Yang et al,. 2015).

Aversive Values

Studies of humans suggest that aversive and hedonic values, although related, have different impacts on behaviors (Davis & Reyna, 2015; Winer and Salem, 2016). Fear forms in response to an expectation of aversive events, and acts as major inhibiter to many important survival behaviors that an organism would otherwise perform (LeDoux, 2012; Orsini & Maren, 2012). High fear tolerance may result in a complete disappearance of fear as a factor. Risk taking behaviors in humans include extreme sport activities, high risk investments, and dangerous occupations (Keifer, Hurt et al., 2015). On the other hand, low fear tolerance may lead to development of phobias and other fear control disorders (Lang, McTeague et al., 2014).

The fear processing circuitry seems to be complex and involve several brain regions (Dejean, Courtin et al., 2015). A large body of evidence suggests that fear processing requires synaptic changes within the amygdala (Kim & Jung, 2006), but also might involve other brain regions including the prefrontal cortex and hippocampus (Anagnostaras, Gale et al., 2001; Aoki, 2016). The serotonin transporter gene, dopamine-related genes, and neuroplasticity-related genes are implicated in facilitated fear conditioning and attenuated fear extinction (VanElzakker, Dahlgren et al., 2014; Sumner, Powers et al., 2016).

Summation: Dissolution and Discounting Parameters of Hedonic/Aversive Values

Pairing a stimulus with another one changes the value of the stimulus (De Houwer, Thomas et al., 2001; Baeyens, Field et al., 2005). The process of evaluative conditioning (also known as evaluative learning, and affective learning) leads to dissolution of the original value of the stimulus. Evaluative conditioning can be considered as a form of Pavlovian conditioning, but more resistant to extinction, independent of contingency awareness, unaffected by modulation procedures (De Houwer, Thomas et al., 2001).

The values are also subject to discounting due to their relevance; for example, when the event is delayed in time (Green, Myerson et al., 2004; Jimura, Myerson et al., 2009; McKerchar, Green et al., 2009; Schlund, Brewer et al., 2015). Studies demonstrated that in animals, discounting manifests more steeply compared to humans, and discounting in animals does not reflect the reward amount (Mazur, 2000). The distinct rate of reward discounting as opposed to punishment discounting may play a significant role in the evolution of cooperation (Gao, Wang et al., 2015). In humans, the rate of value discounting determines multiple behavioral choices, such as strategy of investment, many aspects of reproductive behaviors, strategies of raising children, and drug seeking behaviors (Peters & Buchel, 2011). Impulsive individuals are characterized by steep discounting of delayed rewards (Kirby, Petry et al., 1999; Kable & Glimcher, 2007).

Brain injuries, especially of the prefrontal cortex, affect the parameters of discounting in an individual (Barker, 1995; Vogeley, Kurthen et al., 1999; Gao, Wang et al., 2015). Data from functional magnetic resonance suggests the importance of several other regions for the process, including the ventral striatum and posterior cingulate cortex (Kable & Glimcher, 2007; Peters & Buchel, 2010). Behavioral analysis of rodents with reduced cortical GABA synthesis and release, indicates that inhibitory neurotransmission (GABA) may play a key role in discounting (Paine, Cooke et al., 2015).

Threshold, a Relationship between Predicted Outcome Magnitude and Initiation of Behaviors

Threshold describes the relationship between outcome magnitude and initiation of behaviors. If predicted outcome magnitude is very small, the response is less likely. The delay of initiation of behaviors may trigger analysis of additional aspects of events (see hedonic and aversive value assignments described above). We proposed the term “threshold” because the term “impulsivity”, used by many in this context, is often not clearly separated from value discounting (Kocka & Gagnon, 2014) and commonly has a negative connotation (Evenden, 1999). Nonetheless, the concepts of impulsivity and the threshold have a significant overlap.

Studies in adolescent monkeys link impulsive behavior (high-risk/high-gain strategy) to higher rank attainment in the group (Fairbanks, Jorgensen et al. 2004), better sexual motivation and performance (Cummings, Clinton et al., 2013). Benefits of impulsive behaviors may be also observed in humans (Dickman, 1990), making it possible that some aspects of impulsivity could be beneficial traits in evolution. Nonetheless, negative aspects of impulsivity, including effects on obesity and risky sexual activities, are also recognized (Charnigo, Noar et al., 2013; Volkow, Wang et al., 2013). A number of pathological conditions result from improper impulse control, including attention deficit/hyperactivity disorders, addiction, and vulnerability to suicide (Winstanley, Eagle et al., 2006; Courtet, Gottesman et al., 2011; Hayward, Tomlinson et al., 2015; Jimenez, Arias et al,. 2016).

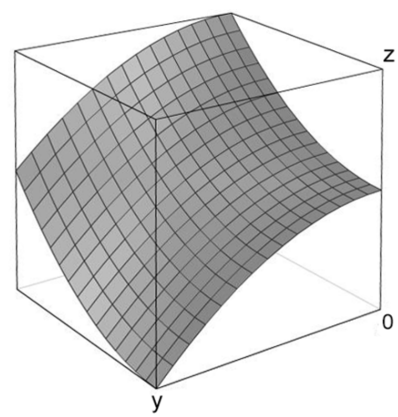

Figure 2. A Function Grapher was used to illustrate how aversive and hedonic values (x, y, ranges for each are from 0 to 100) affect the response to an event (z) in an individual with known parameters of summation and threshold (e, k).

The orbitofrontal cortex and amygdala are involved in value updating and goal selection in primates (Wellman, Gale et al., 2005; Murray, Moylan et al., 2015). Impulsivity is related to the activity of brain regions underlying reward sensitivity and emotion regulation, including the anterior cingulate cortex (ACC) and amygdala (Kerr, Avery et al., 2015). Impulsivity is also associated with reduced prefrontal regulation of the striatum (Mason, O'Sullivan et al., 2014). A polymorphism in D4 receptors and in serotonin 2B receptors is associated with impulsive behavior in both humans and animals (Wong, Buckle, 2000; Hejjas, Vas et al., 2007; Bevilacqua, Doly et al., 2010; Fairbanks, Way et al., 2012; Hayward, Tomlinson et al., 2015; Tikkanen, Tiihonen et al., 2015).

Mathematical Model

Since the individual hedonic and aversive values are the core concept of the functional personality model, this part of the model can be expressed as a mathematical equation that establishes a relationship between aversive (A) and hedonic values (B) and behavioral choices (C). Excellent mathematical models of choice behavior were developed previously (including (Kahneman and Tversky, 1979; Antonini, Bierlaire et al., 2006)), and the attempts to describe a relationship between personality traits were made (Mehrabian, 1996). Our model is different and accounts for both values and parameters of summation. In the field of neurophysiology, summation is defined by a number of synaptic inputs and by the effects of their discharge (including dissimilar frequencies of such discharge). Here, the coefficient k reflects the conversion rate of hedonic and aversive measures. The adjuster e defines a degree to which high aversive or hedonic values gives the response additional sway toward near-certainty and at the same time discounting very low values from taking effect. If C is the strength of behavioral response to an event n ($C_n \in [-\infty,\infty]$), it can be estimated based on following formula:

$$C_n = {B_n}^e - (kA_n)^e$$

A – aversive measure of an event n after all applicable discounting, $A_n \in [0,\infty]$.

B – hedonic measure of an event n after all applicable discounting $B_n \in [0,\infty]$.

k – conversion rate of aversive and rewarding measures (defined for each individual, $k > 0$). This is the reflection of dissolution process during Summation.

e – a degree to which high values sway the responses toward certainty (also defined on individual bases, $e \geq 1$). This is a reflection of impulsivity of an individual. It is possible that future studies may indicate the exponent e for A and B has to be different (e_A for A, e_B for B).

The model is fully computable. Distinct personalities predicted by the functional personality model can be visualized using a 3D Function Grapher (Figure 2).

Special attention should be given to the analysis of the effect of errors in estimation of A,B on the outputs C of the model. Since the response is in general (when e≠1) non-linear in A,B comparable measurement errors at different places in the ranges of A and B will cause significantly different predictions.

It is practical to express the response to an event as a probability ($P_n \in [0,1]$), but this is problematic, as $C_n$can be negative. Among the options that allow converting C values to probabilities would be to linearly map$[-kN^e; M^e]$ to [0; 1] using the function

$$[-kN^e; M^e] \ni \mathrm{C} \mapsto \frac{C + kN^e}{M^e + kN^e} \in [0,1]$$

In order to achieve good behavioral predictions in humans, the functional testing and tuning of the model are critical. Here we attempted to see, if such testing and tuning is feasible. To this end, we compare actual responses of individuals to responses predicted by the model.

Materials and Methods

Convenience sampling was used to recruit participants from a midsized university in the northern panhandle of West Virginia. Participants (N = 37) were aged between 19 and 49, with 17 males and 21 females. All data were collected to comply with research standards protecting the identity of the research participants. The questionnaire was reviewed and approved by the

University Human Research Committee. All participants provided written informed consent.

The questionnaire was introduced in a quiet environment of an empty classroom or an office between 9-4 pm. Although not formally scripted, all interaction between the researcher and participants were consistent across the study (see below). Participants were presented with a questionnaire in which they were asked to 1) estimate the hedonic and aversive values of a range of events; and 2) estimate likelihood of a specific behavioral response for a scenario when when a hedonic event(s) and aversive event(s) occurs simultaneously. For example, after estimates of the hedonic value of "an awesome party" and the aversive value of "fight with a parent", the participant was asked to answer a question "Would you go to an awesome party if as a result of it you are going to have a fight with one of your parents?"

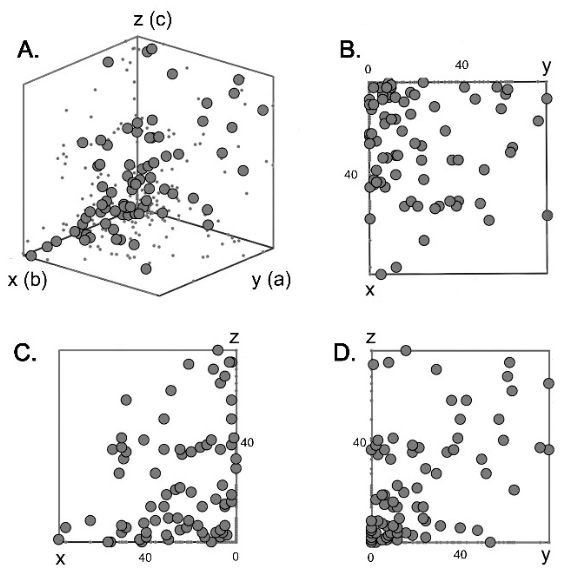

Figure 3. In panel A, the response to a scenario (z(C)) is plotted in a 3D plot as a function of relevant hedonic (x(B)) and aversive values (y(C)). The remaining panels B, C and D represent XY, XZ, and ZY projections of the plot.

The questions regarding aversive values, rewarding values, and scenarios were printed on different pages. In all cases, the participants were sitting at a desk in front of the researcher. The researcher was quietly observing the process and listening to comments without soliciting them. The time that individual used to complete the questionnaire was recorded.

A concern was raised that asking people to value hedonic/aversive experiences may trigger a desire to groom the answers to the scenarios. The priming could not be avoided fully, but to decrease such probability we 1) explained the participant only a very general idea of the study, but did not specify the exact calculation; 2) had a number of distractive questions in our questionnaires; and 3) used an original, not common in everyday life, method to value the hedonic and aversive estimates and responses to scenario (see below). We also tried to minimize the potential that a participant could feel disvalued by being treated as a subject of a study, recognize the test as a challenge, and try to beat it. To this end, the participants were informed that we see high value in his/her participation (such statement was in the consent form and also was repeated by investigator before the administration of the questionnaires). Finally, we were concerned about effect of fatigue on participant's responses. Therefore, we kept the questionnaire short, and most of the individuals completed it in less than ten minutes.

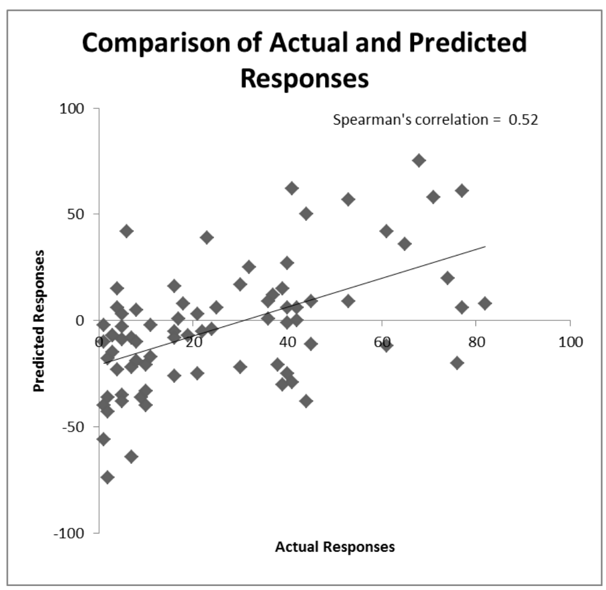

Figure 4. Comparison of actual and predicted responses was completed using Spearman's rank correlation coefficient. The analysis demonstrated weak, but statistically significant prediction power across all scenarios ($t(76)= 2.00$, $p < 0.001$).

In the first part of the questionnaire, the participants were asked to indicate the hedonic values in aversive units (B) and aversive values in hedonic ones (A). We suggested a very weak aversive stimulus (finger prick) and asked participants to estimate how many finger pricks they would endure for a specific hedonic experience. Similarly, the aversive experiences were valued by an individual reporting the amount of money (in U.S. dollars) he/she would be willing to part with to avoid a particular negative event. All responses were entered by the individual on an 84 millimeter analog scale by drawing a perpendicular line, and were collected for the study as continuous data (B and A are measured in millimeters).

In the second part of the questionnaire, a participant was presented with 3 scenarios in which this individual was asked to estimate a probability of choosing certain behavioral response when a desirable event is paired with an aversive condition. Such demonstration of a probability as opposed to a simple “Yes” or “No” was critical for our analysis. Therefore, the answers to the scenario that corresponded to absolute “Yes” or “No” were disqualified and excluded (36 measures). Each scenario offered an abstract situation, not connected to a specific time or place (please see an example of such scenario presented in the second paragraph of this section). We hoped that this design allowed us to minimize effects of value discounts. The descriptions of the events in the scenarios were consistent with the description of the events used for the value estimates. We hoped that such approach could minimize the possibility of triggering new associations. It was clear that the introduction of additional values could affect the responses in the scenario. The responses were entered by drawing a perpendicular line on an 84 millimeter interval from 0 (“never in my life”) to infinity (“yes, for sure”), the middle of the interval was offered as an uncertain response (“50/50”).

Individual responses to the question in the second half of the questionnaire were predicted based on the reported aversive and hedonic values of the events as described in the first formula and then compared to the actual responses of the same participant (both k and e in this study had a value of 1). The prediction (C, mm) of the position of the response made by the participant on the 84 mm in the second part of our questionnaire was done using the following calculations:

$$C = \frac{B-A}{2} + 42$$

Predictive power of the model was estimated using R program (version 3.1.1, R Core Team, 2015).

Results

Several individuals commented while taking the questionnaire that the aversive value of one finger prick or hedonic value of receiving one dollar bill is minimal. Nonetheless, every participant provided us with requested scaling of aversive and hedonic events using these units. Interestingly, the majority of our participants gave a higher absolute value to the negative units of measure than to hedonic units when they were asked to compare the units directly in one of the questions on the test. Participants also expressed no concern regarding our assignment of events to aversive or hedonic categories. The different categories of questions were located on different pages of the printed questionnaire, and none of our participants attempted to correct or even reread the pages that had been already filled.

Many participants stated that they needed additional details related to the event in order to answer the scenario questions. Some even named the added dimensions during the test. During the questionnaire, none of the participants stated any impatience or displeasure. At the end of the test many participants expressed great interest in being informed regarding the progress of the research project (it was not a solicited response).

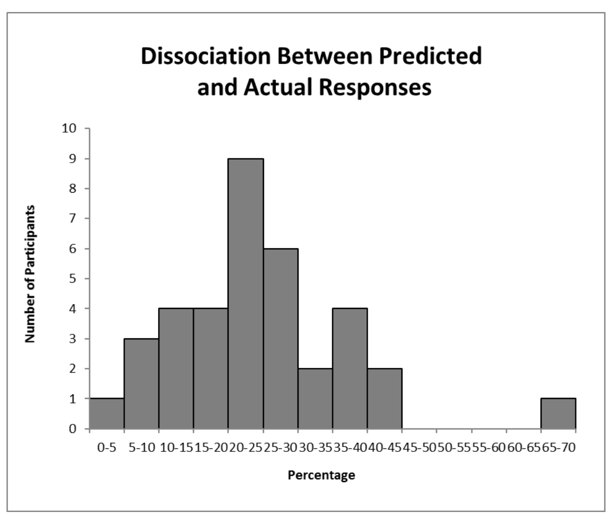

Figure 5. Frequency histogram illustrates the differences between predicted and actual responses for individual participants (the average difference is 25+/-13%, N=34).

The participants gave a broad range of responses regarding aversive/rewarding values of specific hedonic and aversive events, as well as a wide variety of responses for scenario questions (see Fig. 3). Gender, age of participants, and time on the task did not have an apparent influence on the responses. As we described in the Methods, the hedonic and aversive values, reported by each individual were used to forecast actual responses to each scenario. The resulting predictions were compared to reported responses of individuals (Fig 4). In both cases the data were not normally distributed, and the assumption of finite variances was questionable, so we applied Spearman's Rank-Order correlation as a more robust correlation methodology. Spearman's correlation demonstrated relatively weak (0.51, 0.52, and 0.45), but statistically significant prediction power ($p<0.05$) for each of the scenarios. We also used Pearson's correlation coefficient that detected a comparable relationship (0.58, 0.54, 0.46, $p<0.05$). The power calculations demonstrated that our study ($n=37$, $r=0.50$, sig. level = 0.05) had 0.90 power. It was also clear that the model suited some individuals better than others. Our predictions for 11 out of 34 individuals dissociated in average from actual responses of the same individual for less than 20% (the error was calculated as % of the total scale, Fig 5).

Discussion

During everyday activity we complete a large number of tasks, including walking, recognition of faces, and making predictions about the behavioral choices of other individuals we know. Here, we attempted to create a functional model of personality that may formalize the latter human ability. The model parameters are based on advances of neuroscience and are expressed mathematically. The model describes the relationship of personality parameters with each other, and the influence of personality parameters on behavioral choices.

The proposed functional personality model has an undeniable connection with the models previously available. The difference is that we treat some of the previously proposed traits, including honesty-humility, extraversion, and novelty seeking, as values (Cloninger, 1987; Cloninger, Svrakic et al., 1993; Ashton and Lee, 2007); other traits, including neurotisism, as part of the summation process (Ellis, Abrams et al., 2009); and the rest, including conscientiousness and activity, are treated as an expression of threshold (Zuckerman, 1992). Though with some limitations, the available personality tests may accelerate further development of the functional model.

Here, we attempted a very bold test of the model's feasibility as we tried to predict a very specific behavioral choice as opposed to more general predispositions. Foremost, it is acknowledged that a small sample size with a one time self-reported survey was used. This investigation was exploratory and primarily concerned with the feasibility of the prediction model. Future studies should employ larger, more diverse samples, include additional biological measures, and employ a longitudinal design with counterbalancing of questions.

Even though the functional personality model apparently has somewhat improved prediction power compare to previous personality models (Hurtz and Donovan, 2000; Paunonen, 2003), we still failed to demonstrate a strong correlation. Multiple factors may contribute to the shortage. First, we did not take any parameters of summation (individual k and e), into the account. Obviously, development of accurate measures for k and e is a challenging task, as the efforts have to be focused on each specific individual. It is possible that the e and k may have to be estimated based on procedural measures (observation of actual choices), as opposed to a self-reported one, as was applied here. It remains to be seen if non-verbal measures, including motor responses, blood pressure parameters, galvanic skin responses, and noninvasive methods of brain imaging (Boyle, Matthews et al., 2008) could improve accuracy over questionnaires. The second reason is related to the fact that we failed to consistently dissect only two values for our experiment. We strongly believe that additional value associations were triggered at least in some participants despite all our efforts. We consider this interference the biggest single factor that negatively affected the prediction power in our tests.

If the aim is a careful prediction of all responses, all values have to be taken into account. It should be recognized, that many of these values are constantly changing due to new experiences and a complex environment. Some may even see such design of the model as an exit clause that could be used every time when this model failed to deliver. Still, we hope to identify the relatively more stable core values of a person. A list of the core values probably includes safety, novelty, sexuality, socialness (Maslow and Frager, 1987; De Houwer, Thomas et al., 2001; Baeyens, Field et al., 2005), as well as values of specific social connections, specific hobbies, and specific favorite activities. Everyday observations suggest that the latter values are critically important for understanding a particular person, and they are essential for creating of the functional model of personality. Knowing the core values and how they interact, we hope that one day it could become possible to predict the hedonic/aversive value of a wide variety of complex events without asking an individual about them directly.

It is should be recognized that the functional model will always have a limitation: it will never fully reflect brain plasticity. Mounting evidence indicates dynamic changes in the brain in response to behavioral outcomes, environmental stimuli, emotions, and even circadian rhythmic activity (Pascual-Leone, Freitas et al., 2011). These fluctuations are difficult to incorporate in the model, however, with additional research these variations could be more clearly defined and used to assist in prediction. It should be acknowledged that dissociation between a functional personality and the actual person will always be in place, and the differences will be further accumulated over time, swiftly decreasing the predictive power of the model. In other words, the functional model of personality will never devalue, but only celebrate the human mind.

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