

An Economic Model of Personality and Its Implications for Measurement of Personality and Preference From: *Personality Psychology and Economics*

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**Beyond Correlation in the Study of Personality:
Associations, Investments and Interventions**

Session 1

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Goals

- 1 To place the concept of personality within economic model(s).

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- b Distinguish manifest (measured) personality from personality traits.
- c To use the economic model(s) to frame and solve a central identification problem.
- d How to go from measurements of personality to personality traits.

Personality and Personality Traits

- Distinguish **personality traits** from **measured personality**.

- Personality traits as defined by one leading personality psychologist defines personality traits in the following way:

Roberts [2009, p. 140]

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- This definition, or closely related versions, are used throughout personality psychology.

- Cervone and Pervin [2009] define personality as

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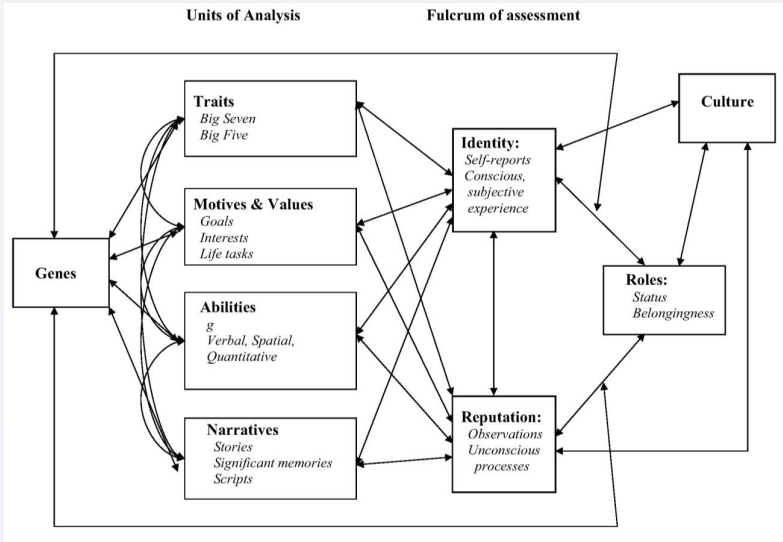
“psychological qualities that contribute to an individual’s enduring and distinctive patterns of thinking, feeling and behaving.”

- Another definition emphasizing context:

McAdams [2006]

“Personality is a patterning of dispositional traits, characteristic adaptations, and integrative life stories set in culture and shaped by human nature.”

Figure 1: Roberts's Model of Personality Psychology



An Economic Framework for Conceptualizing Personality and Personality Traits

- The most direct way to introduce psychological variables into economic models is through constraints.

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- Thus IQ, achievement tests and personality variables affect earnings because they are productive traits (see, e.g., Bowles, Gintis and Osborne [2001a]), and, up to a point, more of a trait can generate more resources.

- A second way to introduce such variables is through preferences.

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- A third way is through expectations.

A Framework Based on Comparative Advantage

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- Heckman, Stixrud and Urzua [2006] use the Roy model to introduce psychological variables into the study of social and economic outcomes.

- Agents can perform one of J tasks with productivity P_j , $j \in \{1, \dots, J\}$.

- The productivity in task j depends on the traits of agents θ , and the “effort” they expend on the task, e_j :

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- Productivity also depends on effort e_j .
- Effort is assumed to be divisible and fixed in supply.

- Effort and traits are often assumed to be measured so that over the relevant range

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- Neither condition is strictly required.

- Effort may complement capability

$$\left(\frac{\partial^2 P_j}{\partial e_j \partial \theta} > 0 \right)$$

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- Effort can be a vector (time, mental energy, attention), and it is assumed to be a divisible private good with the feature that the more that is applied to task j , the less is available for all other tasks at any point in time.

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- Baumeister, Bratslavsky, Muraven et al. [1998] interpret self-control as a component of e that is fixed over given time periods. (More self-control in one task leads to less in another task.)

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- In this case, θ and \bar{e} play the same role because only one task can be performed at any time and all effort is devoted to it.

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- Persons with different endowments of personality and intelligence sort into different occupations and levels of schooling.
- People low in certain traits may have better endowments of effort and may compensate by exerting effort.
- For certain tasks (e.g., creating new branches of mathematics), there may be threshold levels of θ such that for $\theta < \bar{\theta}_j$, $P_j(\theta, \bar{e}) = 0$ no matter what the level of \bar{e} .

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- The higher R_j , the more likely will the person select to perform task j .
- The particular choice of which j to perform depends on the productivity of traits in different tasks.

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- A less discrete version (case II) builds on the same foundations, and allows people to perform multiple tasks at any time and postulates that $\phi_j(\theta, e_j)$ is concave and increasing in e_j .
- The agent maximizes

$$\sum_{j=1}^J R_j P_j(\theta, e_j) \quad (3)$$

subject to

$$\sum_{j=1}^J e_j = \bar{e}.$$

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- Now effort allocated across tasks.

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- Divide θ into “mental” (μ) and “personality” (π) traits.
- θ_μ and θ_π , each of which may be a vector.
- This corresponds to the two types of traits in Roberts' model, presented in Figure 1.

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- To use performance on a task (or on multiple measures of the task) to identify a trait requires that performance on certain tasks (performance on a test, performance in an interpersonal situation, etc.) depends exclusively on one component of θ say $\theta_{1,j}$.

- In that case

$$P_j = \phi_j(\theta_{1,j}, \mathbf{e}_j).$$

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- Even if we can measure productivity in j , P_j , and only one component of θ affects P_j , to identify the level of a trait one must control for the level of effort applied to j in order to use P_j to infer the level of $\theta_{1,j}$.
- One must standardize for the effort at a benchmark level, say e^* , to use P_j to identify a measure of the trait that is uniform across different situations that elicit different levels of effort.

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- If effort is involved in the performance of a task to uniquely define a trait, the measurement of performance must be standardized in order to use measured productivity P_j to identify the trait.
- Otherwise, the endowment of effort, and all of the factors that contribute to the exertion of effort, including the reward to the task, R_j , will contaminate the measure of the trait.

- Failure to adjust for effort produces the kind of variability across situations with different rewards that was much discussed in the person-situation debate.

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- But in general, even having two (or more) measures of productivity that depend on $(\theta_{1,\mu}, \theta_{1,\pi})$ is not enough to identify the separate components.

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- Note that if the support of e_j and $e_{j'}$ is disjoint, no $(\theta_{1,\mu}, \theta_{1,\pi})$ exists.
- If the system of equations satisfies a local rank condition, then one can solve for the pair $(\theta_{1,\mu}, \theta_{1,\pi})$ at e^* .

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- Scores on achievement tests depend on both IQ and personality traits.
- In the absence of dedicated constructs (constructs that are generated by only one component of θ), there is an intrinsic identification problem that arises in using measures of productivity in tasks to infer traits.

Extensions

- Attach a cost $C_j(\theta, e_j)$ to obtain the reward so that instead of criterion (2), the agent picks \hat{j} that maximizes the net reward

$$\hat{j} = \arg \max_{j \in \{1, \dots, J\}} \{R_j P_j(\theta, \bar{e}) - C_j(\theta, \bar{e})\},$$

and instead of (3), for case II the agent maximizes with respect to the choice of e_j

$$\sum_{j=1}^J R_j P_j(\theta, e_j) - C_j(\theta, e_j).$$

- This extension creates a further identification problem—whether the trait identified arises from its role in costs, productivity, or both.

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- In most applications the $P_j(\theta, e_j)$ and $C_j(\theta, e_j)$ (or their logarithms) are assumed to be linear or log linear in θ and e_j :

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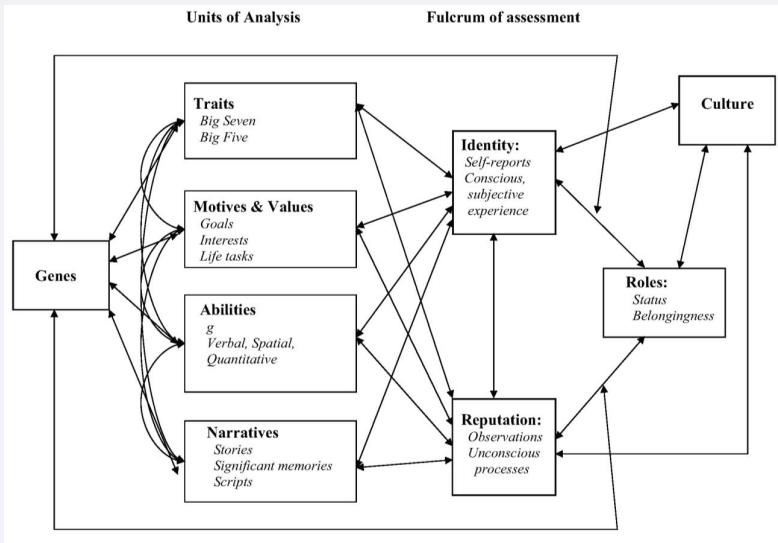
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- A third (mixed) case (III) can arise in which some clusters of tasks are mutually exclusive so the agent can perform only one task within each cluster of tasks, but the agent can simultaneously engage in multiple tasks across clusters.

Adding in Preferences and Goals

- Preferences and goals (see Figure 1) may also shape effort.

Figure 1: Roberts's Model of Personality Psychology



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- Array the effort across tasks in vector $e = (e_1, \dots, e_J)$.

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- Output can produce income $\sum_{j=1}^J R_j P_j$ which can be spent on goods X with associated prices W .
- A utility function can be specified over P , e , and X with preference parameter vector η .

- Thus, we may write preferences of agents as

$$U(X, P, e \mid \eta), \quad (4)$$

where the agent maximizes (4) subject to the constraints

$$Y + R'P = W'X, \quad (5)$$

where Y is a flow of unearned income available to the agent in addition to his earnings from his productive activities, and

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 - (c) agents may value the effort devoted to tasks.

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- Parameters that affect subjective well-being but not choices can be identified from the measures of well-being, but not from choices.

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- In a general specification, agents can be uncertain about their preferences (η), their traits (θ), the prices they face (P), the outcomes of purchase decisions (X), and their endowments of effort (\bar{e}).

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- Thus, the derived productivity and effort functions would constitute measured personality as a response to constraints, information, and preferences, i.e., as functions that solve out for the P_j and e_j that agents choose.
- This approach would not capture the full range of behaviors considered by personality psychologists as constituting aspects of personality except as a reduced form expression.

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- Thus, in selling a house, various actions might be taken, e.g., smiling, persuading people by reason, threatening, scowling, showing affection, etc.

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- Thus, in selling a house, various actions might be taken, e.g., smiling, persuading people by reason, threatening, scowling, showing affection, etc.
- Colloquially, “there are many ways to skin a cat.”

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- The actions may be the same or different across the tasks.
- Thus one can smile in executing all tasks or one may smile in only some.

- The productivity of the agent in task j depends on the actions taken in that task:

$$P_j = f_j(a_{1j}, a_{2j}, \dots, a_{K_{jj}}). \quad (7)$$

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- The actions themselves depend on traits θ and “effort” $e_{i,j}$:

$$a_{i,j} = \nu_{i,j}(\theta, e_{i,j}), \quad (8)$$

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$$\sum_{i=1}^{I_j} e_{i,j} = e_j \text{ and } \sum_{j=1}^J e_j = \bar{e}.$$

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- Less effort may be required to perform a given action if a person has endowment θ that favors performance of the action.
- Stated this way, actions generalize the notion of effort to a broader class of behavior.

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- A special case is when there are increasing returns to effort in each action.
- In that case, the agent will simply apply all of his effort e_j in task j to the action which gives him the highest productivity, and the other possible actions are not taken.

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- We can define the utility over actions.
- Let a denote the choice of actions applied to all tasks ($a = (a_1, \dots, a_J)$).

- The agent solves

$$\max U(a, X, P, \eta \mid \mathcal{I})$$

with respect to X , e given the previously stated constraints.

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- Actions may also directly affect \mathcal{I} , so the production of information can depend on θ , e and a .
- The choice of which actions to take depends on goals and values (captured by η) and on the available information.

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- These situations are assumed to affect productivity by affecting the set of possible actions and hence the action taken.

- Thus for a person with traits θ and effort vector e_j with action $a_{i,j}$, using the specification (8), the action function can be expanded to be dependent on situation h :

$$a_{i,j,h} = \nu_{i,j,h}(\theta, e_{i,j}), \quad (9)$$

and productivity on a task can be specified solely as a functions of the action taken to perform the task

$$P_{j,h} = f_j(a_{1,j,h}, \dots, a_{K_j,j,h}) \quad (10)$$

or in a more general specification where situation h , along with traits, has a direct effect on productivity in addition to their effects on actions taken.

$$P_{j,h} = f_{j,h}(\theta, a_{1,j,h}, \dots, a_{K_j,j,h}). \quad (11)$$

- Situations could include physical aspects of the environment in which the agent is located or the network (and other social situations) in which the agent is embodied.

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- Failure to control for situation h , just like failure to control for effort, will contaminate identification of traits using measures of actions or productivities.
- Situations may be forced on the agents or may be chosen.

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- For simplicity, we analyze this case.
- For the case of fixed h , the solution to the maximization problem produces a set of response functions.

- Preference parameters (η) determine the choices and actions taken through their influence on the tradeoffs and goals that characterize consumer preferences:

$$\text{Personality} \left\{ \begin{array}{ll} X = X(T, h, W, Y, R, \mathcal{I}) & (12) \\ e = e(T, h, W, Y, R, \mathcal{I}) & (13) \\ a = a(T, h, W, Y, R, \mathcal{I}). & (14) \end{array} \right.$$

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- Productivity P across tasks is derived from the actions, efforts, and traits of the agents.
- **The behaviors that constitute personality are defined as a pattern of actions in response to the constraints, endowments, and incentives facing agents given their goals and preferences.**

- This interpretation incorporates the notion that personality is a strategy response function (14).

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- People may have different personalities depending on their trait endowments, constraints, and situations.
- The actions—not the traits—constitute the data used to identify the traits.

- Personality psychologists often use actions (e.g., “dispositions”) to infer traits.

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- The same identification issues previously discussed continue to arise but now apply to a broader set of measurements.

Life Cycle Dynamics

- Let T^τ be traits at age τ , $\tau \in \{1, \dots, T\}$.

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- Information \mathcal{I}^τ may be updated through various channels of learning.

- The technology of skill formation (Cunha and Heckman [2007; 2009]) captures the notion that traits may evolve in response to the inputs of a vector of investments (IN^τ), and through aspects of the situation in which the agent is found, h^τ , where S_{h^τ} is the vector of attributes of the situation:

$$T^{\tau+1} = f^\tau\left(\underbrace{T^\tau}_{\text{self-productivity}}, \underbrace{IN^\tau}_{\text{investment}}, S_{h^\tau}\right), \tau = 0, \dots, T-1 \quad (15)$$

where the first set of arguments arises from self and cross productivity (so skill begets skill; traits beget other traits and traits cross-foster each other).

- Notice that if elements of T^τ are augmented over the life cycle through investment and practice, the actions and efforts required to achieve a given task can change.

- As emphasized by Mischel and Shoda [1995], situations may change over time as a function of past actions, past situations, investment, information, and the like.

$$h^{\tau+1} = \psi^{\tau}(h^{\tau}, IN^{\tau}, a^{\tau}). \quad (16)$$

- Information \mathcal{I}^τ may also change over the life cycle through experimentation as well as through exogenous learning:

$$\mathcal{I}^{\tau+1} = \phi^\tau (\mathcal{I}^\tau, a^\tau, T^\tau, IN^\tau, h^\tau). \quad (17)$$

Relationship of the Model in This Section to the Existing Models in Personality Psychology

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- It emphasizes the role of traits (T) and, in particular, the Big Five factors in producing outcomes and agent actions and is sketchy about other details.
- Agents are assured to learn about their own traits, but precise learning mechanisms are not specified.
- Expression of traits is affected by the external environment and through social interactions in a not fully specified fashion.

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- People learn about their traits through actions and experience, but how this occurs is not given.
- These notions are captured by equation (17).
- Situations may also evolve as a function of actions and experience, but no role is assigned to investment.

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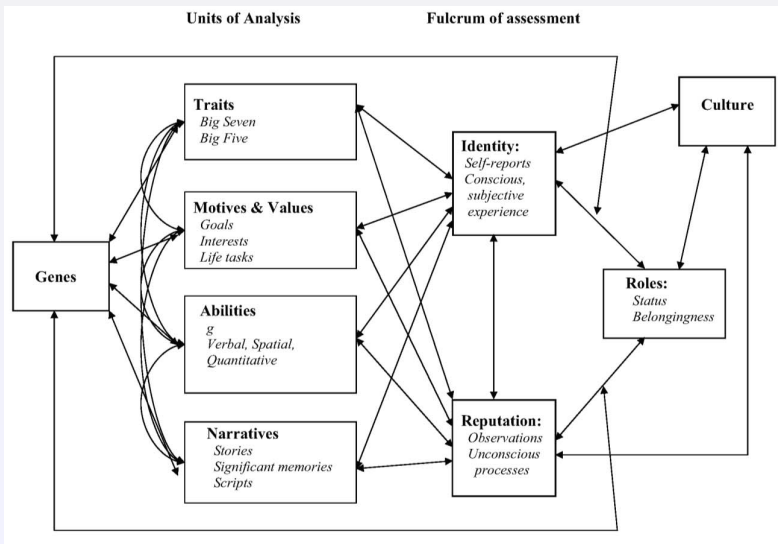
- Thus, a restricted version of (16) formalizes aspects of the Five Factor Theory.
- The theory features “characteristic adaptations,” which correspond to the actions and efforts of our model that also affect the productivity in tasks.
- The role of preferences is left unspecified.
- However, Costa and McCrae explicitly feature rationality (McCrae and Costa [2008, p. 161]) and reject the characterization of flawed human decision making that dominates social psychology and the field of behavioral economics that was spawned from social psychology.

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- Central figures in this literature are Albert Bandura, Daniel Cervone, and Walter Mischel.
- Roberts’ diagram (Figure 1) captures key aspects of this theory.

Figure 1: Roberts's Model of Personality Psychology



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- Goals and motives are captured by η .
- Although the personality psychology literature contrasts these two lines of thought, to us the lines are not distinct.
- In one extreme version of the social-cognitive theory, traits are entirely absent.
- Mischel and Shoda [2008] focus on the role of situation in shaping actions, efforts, and productivities, but, as previously discussed, also allow for traits to influence actions.

- Thus, both schools of thought accept specification (8) or its extension (9), and both would be comfortable with response systems (12)-(14).

Reforming the Situational Specificity Hypothesis

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- Boiled down to its essence, this hypothesis says little more than that situations affect actions and efforts in a nonlinear fashion, i.e., that in equations (13) and (14), situational variables enter in a nonlinear fashion.

$$e = e(T, h, W, Y, R, \mathcal{I}) \quad (13)$$

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- This interaction effect is the Mischel-Shoda [1995] “if-then” relationship.
- To our knowledge, there are no studies available that parse the contributions of situations and traits to observed efforts, actions, and productivities.

- Suppose that we observe the set of actions taken in performance of task j in situation $h, a_{i,j,h}$ which depend on θ and $e_{i,j}$:

$$a_{i,j,h} = \nu_{i,j,h}(\theta, e_{i,j}), \quad i \in \mathcal{A}, \quad h \in \mathcal{H}, \quad j \in \{1, \dots, J\}.$$

- The “average action” (i.e., the “personality”) for the situation h in task j averages over, “integrates out” (or sums over) the θ and $e_{i,j}$:

$$\bar{a}_{h,j} = \int_{\mathcal{S}_{j,h}(\theta, e_{i,j})} \nu_{i,j,h}(\theta, e_{i,j}) g_{\theta,e}(\theta, e_{i,j} \mid h) d\theta de_{i,j} \quad (18)$$

where $\mathcal{S}_{j,h}(\theta, e_{i,j})$ is the support of $\theta, e_{i,j}$ for a given h , i.e., the domain of definition of $\nu_{i,j,h}$ function and $g_{\theta,e}(\theta, e_{i,j} \mid h)$, the density of $\theta, e_{i,j}$ given h and j .

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- This is what psychologists mean by actions in a “typical situation” in task j , i.e., one that averages across θ and $e_{i,j}$.

- By the mean value theorem for integrals (Buck [2003]), $\bar{a}_{h,j}$ is the value of $a_{i,j,h}$ at a particular point of evaluation of θ and $e_{i,j}$.

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- One could use $\bar{a}_{h,j}$ as a definition of the situation h -typical action.
- Notice that if $\nu_{i,j,h}$ is separable in h , there would be no person-situation interaction.
- Averaging over tasks ($j = 1, \dots, J$) in an analogous fashion produces the average action produced by a situation, \bar{a}_h .

- By parallel reasoning, the average action for trait vector θ in task j can be defined as repeating these operations, but just for task j .

$$\bar{a}_{\theta,j} = \int_{\mathcal{S}_{\theta}(h, e_{i,j})} \nu_{i,j,h}(\theta, e_{i,j}) g_{h,e_{i,j}}(h, e_{i,j} \mid \theta) dh de_{i,j}$$

where

$$\mathcal{S}_{\theta}(h, e_{i,j})$$

is support of $\nu_{i,j,h}$ and $g_{h,e_{i,j}}(h, e_{i,j} \mid \theta)$, where $g_{h,e_{i,j}}$ is the density of $h, e_{i,j}$ given θ .

- One can think of $\bar{a}_{\theta,j}$ as one definition of the “enduring actions” of agents across situations in task j , i.e., the average personality for trait θ .

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- One can average over tasks to produce an average action for trait vector θ .
- Again, if $\nu_{i,j,h}$ is separable in θ , the marginal effect of θ on actions is the same in all situations.