Running Head: REPRESENTING PSYCHOLOGICAL PROCESSES WITH FUNCTIONAL FIELDS

Formally Representing How Psychological Processes Shape Actions and
One Another Using Functional Fields

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ABSTRACT

Many psychological theories understand that a person's actions are psychologically mediated – i.e., they are caused most proximally by how the person perceives their situation. Here, I discuss how *functional field models* can be used to represent the perceived situation as a path model detailing the *forces* a person understands as connecting actions, features of the environment, and their ultimate appraisal of the situation. I illustrate how specific situational factors can be represented as affecting a person's actions by affecting these perceived forces, and thus their understanding of the action's expected effects. I describe how verbal descriptions of the situation, or of their reasons for action, can be formally represented within field models. Finally, I describe how field models can be used to represent arguments about how traits relate to one another, such as how a person's level of *extraversion* or *callousness* might affect the levels of many other traits. More generally, functional field models can help to represent how people actively construct their environment, and how we can better utilize people's verbal descriptions of their own traits or their reasons for action.

Formally Representing How Psychological Processes Shape Actions and One Another Using Functional Fields

Many theories concern how psychological processes shape actions, and how they shape one another. For instance, expectancy-value models suggest that people will respond to situations in the ways they expect to produce most useful or desirable consequences (Feather, 1982), and much of the interest in broad personality dimensions derives from understanding these as approximating some of the deepest sources of a person's thoughts, feelings, and behaviors (e.g., McCrae & Sutin, 2018; Safron & DeYoung, this volume). Here, I will elaborate on previous treatments of how *functional field models* can be used to formally represent these types of arguments (Wood, Spain, & Harms, in press; Wood, Spain, Monroe, et al., in press; Wood, Lowman, et al., 2017). Functional field models can be regarded as integrating many of Lewin's (1943, 1946) insights regarding the psychological causation of behavior with expectancy-value or rational actor models (Feather, 1982; Borghans & Schils, this volume), and with path analysis or graphical causal models (Pearl, 2009; Wright, 1934). In essence, a field model represents a person's understanding of a situation as a path model, detailing how the person may believe that features of the environment affect one another within that situation. These can then be used to model how the person will perceive the expected outcomes of responding in different ways to a situation, and to estimate which action the person will appraise most positively and actually perform.

I will first describe how functional field models can be used to represent how perceivers translate particular pieces of information about the situation, such as which people and objects are present, into a larger understanding of the nature of the situation at that time. The *perceived situation* broadly concerns the *forces* the person understands as linking more specific features of the environment to one another and to valued outcomes, which create *reasons* to pursue and avoid particular courses of action. I will then detail how *verbal statements* people make about people and situations can be represented within

functional field models. These ideas can be used to more formally represent arguments about how different psychological processes affect one another. For instance, how should we understand a person's level of *extraversion* as being a major source of the level of *assertiveness*, *sensation-seeking*, and *sociability* (DeYoung, 2015; McCrae & Sutin, 2018)?

Basics of Functional Field Models

Kurt Lewin (1943, 1946) proposed that the psychological forces influencing a person's behavior could be modeled using *psychological field models* in much the same way that physical forces acting on objects are modeled using gravitational or electromagnetic field models within physics (e.g., Einstein, 1934). The psychological field model serves as a formal model of the *psychological situation* – the situation as understood by the person at a particular time. Although Lewin's ideas regarding field models have continued to inspire psychologists (Beckmann & Heckhausen, 2018; Kelley, 1997; Kihlstrom, 2013; Rauthmann et al., 2015), the topological models he favored for representing the psychological situation have come to be viewed as insufficiently rigorous (Burnes & Cooke, 2013; Rainio, 2009). The present models will instead represent the psychological situation which serves as the proximal source of behavior in the form of path models (Pearl, 2009; Wright, 1934). Path models were largely unutilized by social scientists in Lewin's time (Kenny, 1979; Pearl & Mackenzie, 2018), but may ultimately be better positioned to formalize Lewin's ideas regarding the psychological forces affecting behavior.

Within the present field models, the core *process variables* that are understood to underlie a person's actions – beliefs such as self-efficacies, expectancies, and values (Bandura, 1977; Mischel & Shoda, 1995; Wood, Gardner, et al., 2015) – are represented as *forces* which the person perceives as linking two features of their environment in certain conditions (i.e., as *edges* linking *nodes* within a network model, see Beck & Jackson; Slaughter, this volume). Formally, field models provide a formal representation of a person's beliefs about how features of the environment affect one another within a particular situation.

Field models can then be used to formally estimate the outcomes a person will expect from performing different actions within that situation. As with expectancy-value models, rational actor models, or other subjective utility models (Feather, 1982; Gintis, 2009; Hastie & Dawes, 2010), the person is expected to perform the action that they have appraised as producing the most positive effects.

The Functionality Assumption

People do not respond directly to the *real* or *objective* situation existing around them, but rather must respond proximally to their *perception* of the situation, a mental representation constructed by integrating the information they have detected, attended to, and processed (Kelly, 1963; Lewin, 1943; Reis, 2008). Importantly, the person's perception of the situation is not necessarily accurate (Brunswik, 1952; Funder, 1995). Indeed, actions resulting in injury or death are often performed precisely because the person's understanding of the situation is inaccurate (Endsley, 1995). For instance, a driver might drive off the road due to an inaccurate expectation they could handle a curve at high speed, which in turn was produced by a failure to notice or correctly interpret important conditions in their environment, like the presence of black ice or their vehicle's high center of gravity.

It is quite common to assume that a person's actions are *shaped* toward their level of functionality to the individual (Borghans & Schiles, this volume; Dennett, 1996; Skinner, 1981; Thorndike, 1913). Wood and colleagues (in press) have recently advocated for a strong form of this functionality assumption:

"At every moment, individuals initiate the action plan that they have appraised most positively given the courses of action that they are considering and their understanding of their circumstances. This statement is assumed to be true for all time and for always: an agent simply can't not initiate the action they appraise most positively" (italics authors').

This understanding is intended to apply to *everything* the person has done and will do, from a person's most deliberative to most automatized actions. This strong form of the functionality assumption is useful for refining formal models of a person's psychological processes. Specifically, it indicates that if we see

someone *do something* – even something we might regard as particularly bewildering or dysfunctional – then the person *must* have believed at some level that the action was the best course of action *at the time the action was selected*. If someone performs an action that even they later agree to regard as dysfunctional, this should mean that *at the time of action* the person either: (1) failed to consider actions that would have appraised more positively (e.g., the person failed to find a solution that would have resolved downsides of more obvious options; Gershman, Horvitz, & Tenenbaum, 2015), or (2) failed to attend to important information about the situation (e.g., due to their ‘attention being elsewhere’, the person forgets they are in public, which disinhibits one of their grosser habits), or (3) misunderstood their action’s likely consequences (e.g., due to errors of predictive processing or affective forecasting; Berridge, 2009; Clark, 2015; Friston et al., 2014; Wilson & Gilbert, 2005), or (4) were in an unusual mood in which certain outcomes were overly valued (e.g., perhaps due to exposure to drugs, chemicals, or pathogens; Ariely, 2008; Flegr, 2013).

Importantly, the appraisals and beliefs which underlie and produce a person’s actions are not necessarily conscious (Yonsatianchot & Marsella, this volume; Kurzban, 2010; Trivers, 2011). For instance, we might see a particular person physically distance themselves from Person A, and later blurt out some cutting insult to Person B, and later find themselves with a lit cigarette in their mouth despite an earnest goal to quit. Such actions may serve to reveal aspects of how the person perceived and appraised their situation not just to other observers, but to themselves as well (Nesse, 2019). They may realize that perhaps they are more scared of Person A, have more disdain for Person B, and at some level have a stronger desire to smoke than they had previously understood. A person’s affective and behavioral reactions to situations thus serve as little clues to the appraisals and beliefs affecting their behavior, not just for other observers, but for oneself as well (Bem, 1972; Wilson, 2004).

More generally, we will frequently see a person perform actions that our model of the person did not predict. Since the strong form of the functionality assumption asserts that a person *always* selects the action they have appraised most positively, such events demonstrate places where our model fails to represent the situation as perceived by the person with sufficient accuracy. Such instances offer clues as to how our model of the person's beliefs and decision-making processes should be improved.

Formally Representing Situations Within Field Models

The way that person p sees a specific set of circumstances t can be represented as the field matrix $\mathbf{F}_{p(t)}$; this corresponds to the *psychological, perceived, construed, or constructed situation* (e.g., Kelly, 1963; Rauthmann et al., 2015; Reis, 2008) and to what Lewin (1943) referred to as a person's *psychological field at a given time*. Formally, the field matrix is a model of the levels of the *forces* the person understands as existing between features of the environment within that situation. A particular force – corresponding to a particular cell within the complete field matrix $\mathbf{F}_{p(t)}$ – can be indicated as $f_{jj'}_{p(t)}$ or $[s_j \rightarrow s_{j'}]_{p(t)}$, and indicates p 's belief about how a one-unit increase in the state level of feature j affects the state level of another feature j' in conditions t . To reduce a proliferation of subscripts, a particular force will usually be denoted in this chapter more simply as $[s_j \rightarrow s_{j'}]$ after first noting the larger matrix $\mathbf{F}_{p(t)}$ containing the force. Additionally, particular features will be subscripted to indicate who or to what party or object the feature 'belongs to'. For instance, the force $[HrsWorked_p \rightarrow Money_p]$ within matrix $\mathbf{F}_{p(t)}$ indicates p 's belief regarding how the number of hours they work will correspond to the number of dollars they will earn – corresponding roughly to the person's *hourly wage*. In contrast, the force $[HrsWorked_p \rightarrow Money_{Company}]$ would indicate the person's belief regarding how much money an hour of their work will generate for their *company*.

Each force $[s_j \rightarrow s_{j'}]$ within a field matrix is equivalent to the *direct effect of s_j on $s_{j'}$* within a path model (Bollen, 1989; Kenny, 1979). Double-arrows will be used, as in $[s_j \Rightarrow s_{j'}]$, to indicate the *total effect* that the level of j is modeled to exert on the level of j through all possible pathways specified within the field model. As with path models more generally, the *total effect* of X on Y involves both *direct* and *indirect* pathways, which can be estimated using standard path tracing rules (Kenny, 1979; Wright, 1934). For instance, for a pizza delivery person, $[HrsWorked_p \Rightarrow Money_p]$ might indicate the total amount of money the person is modeled to earn from an hour of work as a joint function of (1) their hourly salary, (2) their expected tips per hour, minus (3) the expected transportation costs which are not reimbursed by the company and (4) the taxes they will pay, in addition to any other ways our model represents an hour of their work to influence their income. These direct or total forces can be regarded as formal operationalizations of the “if...then” patterns described within social cognitive models (Mischel & Shoda, 1995; Zayas, Lee, & Shoda, this volume), and the *expectancies* described within rational actor models, subjective utility models, or expectancy-value models (Bandura, 1977; Gershman et al., 2015; Gollwitzer, 1990; Heckhausen, 1977).

Among the primary uses of field models is to represent a person’s decision-making processes. We can represent a person’s perception of how the situation t will be structured if action i is performed as $F_{p(t,i)}$. Action i is usually more specifically a course of action that a person is considering performing to respond to that situation, and formally can be modeled as an intervention or disturbance that could be added to the situation (Pearl, 2009). For instance, $F_{p(t,Drive90_p)}$ may represent the structure of the situation the person expects to result from *driving 90 miles an hour* ($i = Drive90_p$) in the conditions that otherwise characterize situation t . For instance: perhaps in situation t , the person is *driving along a busy freeway in the rain and running late to an important meeting*.

Within some of the Figures provided later to show how field models can be graphically represented, actions will be represented by a right-facing triangle, $\triangleright$ (think of pushing *play* on a media device, or *running* a program). Within the field matrix $\mathbf{F}_{p(t,i)}$, the $[i \rightarrow s_j]$ direct forces represent the most *immediate* expected effects expected by performing action i on the levels of features s_j , and the $[i \Rightarrow s_j]$ total forces represents the *total* expected effects of performing this action on the level of these features. In contrast, the final feature of a field matrix $\mathbf{F}_{p(t,i)}$ is always *the person's own ultimate appraisal of the situation*, U_p . Within graphical representations, ultimate appraisals will be represented by a left-facing triangle, $\triangleleft$ (think of pushing *rewind* on a media device, or *reviewing* the results of a simulation). This feature is essentially analogous to an economist's or JDM researcher's *subjective utility* (Borghans & Schils, this volume; Hastie & Dawes, 2010), and plays a central role in determining which action a person will choose to *actually* perform. Following the functionality assumption, it is understood that when considered multiple actions, the person *will* perform the action i which they have simulated as most highly activating this node – if their decision-making process is modeled correctly. A particularly important set of elements within the field matrix $\mathbf{F}_{p(t,i)}$ thus concerns the levels of the $[s_j \rightarrow U_p]$ forces, which indicates the degree to which the level of feature j is modeled as *directly* affecting the person's ultimate appraisal of the situation. These elements correspond to a person's *preference or utility function* within an economic model (Gintis, 2009; Manski, 2000) or their *values* within an expectancy-value model (Feather, 1982), and may correspond to the highest-order *goals* a person is trying to achieve within neural network models (Read & Miller, this volume) or cybernetic models (Safron & DeYoung, this volume). More colloquially, these describe what outcomes the person *most cares about* or *desires*, *most values*, or is *most motivated by* at the time the decision is made.

In these examples, all forces are scaled to be on a *correlational effect size* metric ranging from -1 to 0 to 1, where values near 0 in magnitude indicate there is *no systematic expected effect*, where values near

.10, .25, and .40 can be regarded as *small* (or *nontrivial*), *moderate*, and *large effects*, respectively (Cohen, 1992), and where values near 1 indicate *extremely strong and reliable effects* of X on Y. Note that in some of the examples that follow, we will represent the level of a force using ‘+’ and ‘–’, as in $[s_j \xrightarrow{+} U_p]$ and $[s_j \xrightarrow{-} U_p]$. This indicates that the level of the force is non-trivially positive or negative – perhaps more formally as being within the bounds of $[.1, .1]$ and $[-.1, -.1]$, respectively. Forces within such field models can also be translated to more natural units if variable means and standard deviations are specified (Cohen et al., 2003). For instance, $[i \Rightarrow \text{Money}_p]$ can be scaled to indicate how much money in US dollars (or other monetary units) p is expected to gain or lose if action i is performed.

The Mediation Principle: All Forces Have Mediating Processes, and All Actions Have Reasons

A final principle which informs the construction and interpretation of functional field models is that every ‘direct’ force between factors within a particular field model can be re-represented as an indirect force formed from a combination of two or more forces within a more complete field model of the situation. More formally, this *mediation principle* indicates that every direct force $[s_j \rightarrow s_{j'}]$ specified within some field matrix $\mathbf{F}_{p(t)}$ could be more completely represented as mediated through some pathway $[s_j \rightarrow s_M \rightarrow s_{j'}]$ within a more detailed or elaborated model $\mathbf{F}_{p^*(t)}$. Importantly, s_M can correspond to a set of mediating variables, as it will often be necessary to specify multiple mediators to account for the total effect (Brunswik, 1952, 1955). We can in turn create an even more elaborated model of the person, $\mathbf{F}_{p^{**}(t)}$, detailing the more specific processes mediating the direct forces specified in $\mathbf{F}_{p^*(t)}$. This process of elaborating mediating processes can continue through as many iterations as we find useful, much like the parent who answers their child’s never-ending progression of ‘*why?*’s until the parent just can’t stand it anymore (Funder, 1991; Harms et al., 2016). Since any given functional field model necessarily consists *solely* of representations of direct forces, and since the mediation principle indicates that any direct forces

can always be re-presented as indirect forces in a more complex model, any particular field matrix $\mathbf{F}_p(\mathbf{t})$ can be understood as the point at which the modeler has decided to stop elaborating the arbitrarily complex larger causal process.¹

An important modeling implication of the mediation principle is that the different actions a person is considering for how to respond to a particular situation should not be modeled as being appraised positively or negatively *directly* (Wood et al., 2017), but only *through their expected effects, and the ultimate appraisal of these effects*. This understands that the direct effect of the simulated performance of action i on their ultimate appraisal of the resulting situation in a sufficiently elaborated model of the situation $\mathbf{F}_p(\mathbf{t}, i)$ is always zero, i.e., $[i \xrightarrow{0} U_p]$. If an empirically estimated field structure shows a non-zero level for this force, it indicates we have failed to model some of the reasons the person was motivated to perform action i (Wood et al., 2017). However, the functionality assumption also states that the person *will* perform the action that they have appraised as having the most positive *total* effects – formally, the action i with the highest level of $[i \Rightarrow U_p]$. These ideas together formalize an understanding that a person *never* decides to perform some action ‘as an end unto itself’, but rather *always* does so for *reasons*, selecting the action they expect to produce the most valuable consequences at the time of action.

Within a field model, the least complex *reason* to perform an action will be formed when only two non-zero forces combine to create a positive pathway linking the simulated action to the resulting situation’s ultimate appraisal in the form of $[i \xrightarrow{+} s_j \xrightarrow{+} U_p]$. Note that this corresponds to the types of reasons for selecting an action commonly described in expectancy-value models, with the first and second forces in the pathway representing an *action-outcome expectancy* and an *outcome valuation*, respectively (Feather, 1982; Heckhausen, 1977; Vroom, 1964). Following standard ‘tracing rules’ within path analysis (Bollen, 1989; Kenny, 1979; Wright, 1934), the product of the expectancy $[i \rightarrow s_j]$ and the value $[s_j \rightarrow U_p]$

forms a causal chain which contributes to the total motivational force or expected-value of the action, $[i \Rightarrow U_p]$, which serves to capture the multiplicative *expectancy*×*value* relationship long theorized in psychological process models (Heckhausen, 1977; Nagengast et al., 2011; Tolman, 1938). Verbally, we can describe such reasons to perform action *i* as “the person expected doing *i* would lead to *s_j*, which the person values.” Reasons formed through longer chains can be represented as well by specifying more intermediary *outcome-outcome expectancy*s within the causal chain linking the action’s performance to its appraisal (e.g., $[i \xrightarrow{+} s_j \xrightarrow{+} s_{j'} \xrightarrow{+} U_p]$; Gollwitzer, 1990; Heckhausen, 1977).

If the total effect of a particular pathway connecting an action to its ultimate appraisal within a field is positive (as estimated by multiplying the level of the forces within the pathway; Kenny, 1979; Wright, 1934), this indicates that the person sees a reason *to* perform the action, and if negative, a reason *not to*. When imagining performing an action, there will generally be multiple distinct pathways the person will understand as connecting an action to the resulting situation’s ultimate appraisal, corresponding to the understanding that there will usually be some reasons to perform a given action and other reasons not to – i.e., that most actions have both ‘pros and cons’. For instance, if we ask a person who decided to drive 90 miles-per-hour why they did this, the person might say something like “I felt I needed to speed to get to work on time today, which was important to me; but I also I knew I would be breaking the law, which I felt bad about.” This verbal statement indicates that the person saw both a reason *to* speed and a different reason *not to* speed when making this decision. The first is a positive pathway – one of the action’s ‘pros’ – through increasing the odds of getting to the work on time; $[i \xrightarrow{+} OnTime_p \xrightarrow{+} U_p]$. The second is a negative pathway – one of the action’s ‘cons’ – through breaking the law; $[i \xrightarrow{+} BrokeLaw_p \xrightarrow{-} U_p]$.

For modeling purposes, we would ultimately prefer to replace the plusses and minuses given on the forces with a smaller range of possible values. This pursuit can be aided by applying the functionality

assumption. Specifically: in this case, we know that ultimately the person decided to speed. Consequently, if we accept that these were the two major considerations affecting on the person's behavior, the person's ultimate decision suggests that the first pathway was more positive than the second pathway was negative. Note that the person could give the same exact verbal statement to explain why they ultimately *didn't* decide to speed, in which case the functional assumption would allow us to refine our estimates of the forces operating on the person's behavior in the opposite direction.

The Sources of Forces: How People Use Information to Construct the Psychological Situation
Functional Field Models as Underlying our Model of the 'Field at a Given Time'

Much as the gravitational forces acting on objects are modeled to change dynamically as object positions change within gravitational field models, the forces summarized in $\mathbf{F}_{p(t)}$ should change dynamically as the situation $\mathbf{s}_t$ changes. A person should perceive forces as linking features of the environment only when the situation meets certain conditions.

The equations which determine how person p translates information about the level of situational states $\mathbf{s}_t$ into a broader perception of the situation can be represented within a *functional field model*, $\mathbf{F}_p$. Note that unlike the field matrix $\mathbf{F}_{p(t)}$, which details the nature of the *psychological field at a given time* as described earlier, the functional field model $\mathbf{F}_p$ does not have a time or situation subscript. The functional field model $\mathbf{F}_p$ might be best thought of as a program, providing a formal model of the conditions p believes affect the forces between features of the environment. In other words: it is our model of p 's model of how the world works. The model $\mathbf{F}_p$ can also be usefully represented as a matrix of formulas, where each element of this matrix, $f_{jj'}_p$, provides a formula detailing how the level of force that p expects feature j to exert on another feature j' within specific situation t , (i.e., $f_{jj'}_{p(t)}$ or $[s_j \rightarrow s_{j'}]_{p(t)}$) is determined.

We can represent how corresponding cells within the functional field matrix $\mathbf{F}_p$ and the matrix representing the field at a given time $\mathbf{F}_{p(t)}$ relate to one another using the equations below:

$$\text{Equation 1a: } \mathbf{F}_p(\mathbf{s}_t) \rightarrow \mathbf{F}_{p(t)}$$

$$\text{Equation 1b: } f_{jj'p}(\mathbf{s}_t) \rightarrow f_{jj'p(t)} \text{ (or) } \left[s_j \xrightarrow{f(\mathbf{s}_t)} s_{j'} \right]_p \rightarrow [s_j \rightarrow s_{j'}]_{p(t)}$$

In these equations, $\mathbf{s}_t$ indicates a vector describing the levels of particular situational factors or conditions s_j within situation t . Equation 1a details how the field matrix $\mathbf{F}_{p(t)}$ representing person p 's field at time t is determined by the more specific situational states at that time, and Equation 1b illustrates how we can represent the estimation of a single force within that matrix – where the two representations before and after the “(or)” are different ways of notating the same equation. In essence, if the equation $f_{jj'p}$ is specified, and if the nature of the situation at a given time $\mathbf{s}_t$ is also specified, these will produce an estimate of the force that the person will expect that state s_j will exert on $s_{j'}$ at that time, or $[s_j \rightarrow s_{j'}]_{p(t)}$.²

The lack of a time subscript for the functional field model $\mathbf{F}_p$ indicates that the functional field model is time-invariant; it details that the rules or laws for translating information about the level of features in the situation to an understanding of the forces existing between them are constant throughout the course of a particular simulation. This is similar to the *preference consistency* constraint found in many economic or decision-making models, where a person's preference function or utility function is assumed to be invariant through the course of making a particular decision (see Borghans & Schils, this volume; Gintis, 2009). However, as the *person* changes over time – perhaps by entering different physical or mood states (e.g., alert vs. sleepy, or hungry vs. full, Brown & Revelle; Read & Miller, this volume), or by altering their representations about how the world works through learning (e.g., Ericsson & Pool, 2016; Kelly, 1963; Simon, 1997), the functional field model $\mathbf{F}_p$ should change to accurately represent how the person is processing situational information at the time of action.

A functional field model $\mathbf{F}_p$ can be usefully compared to the physics engines used in video games or other computer simulations. In the same way that a physics engine can be used to simulate the consequences of performing particular actions in a particular physical environment (e.g., given these road conditions: if that person *drives that fast*, will they *make the turn without sliding off the road?*), the functional field model can be used to model how a person will anticipate the consequences of performing particular actions in a particular social environment (e.g., given my boss's personality and today's work agenda: if I *show up late*, will I get *chewed out?* Or *fired?*).

Example. What job should Abigail and Beatrice take? A rudimentary example of how functional field models can be used to generate more specific situations and to model decision-making is given in Table 1 and Figure 1. Specifically, we can imagine *Abigail* and *Beatrice* are both graduating from applied science PhD programs, and each has received an offer to either (1) go into industry to work as an *engineer*, where they would spend most of their time developing products in a lab, or (2) stay in academia to work as a *professor*, where they would spend most of their time interacting with students. We can use these models to simulate which job Abigail and Beatrice are likely to take.

The formulas given within Table 1 serve as the functional field model for this example, and provides a rudimentary theory of how Abigail and Beatrice will experience working at the job they ultimately choose. To operationalize the model, we simply need to specify whether the person whose decision-process we are modeling is *Abigail* or *Beatrice* (persons *A* and *B*), and whether this person is imagining working as an *engineer* or a *professor*. This is done by setting these features to 1 within $\mathbf{s}_t$, to indicate these factors are modeled as *present* or *true* within that particular situation. In this example, Abigail and Beatrice are represented as caring solely about three features of their job: how much the job results in (1) interacting with other people, (2) having money, and (3) interacting with physical objects like machines or computers. Note that the first and third features correspond to the broadest 'people' and

‘things’ dimensions regarded as among the most basic dimensions of individual differences in interests (Graziano et al., 2012; Su et al., 2009). As detailed in Figure 1, Abigail and Beatrice expect that if they were to work as an engineer in industry, they would not spend too much time interacting with other people, they will receive quite high pay, and they would spend a massive amount of time interacting with physical ‘things’ (e.g., products in development). In contrast, both expect that if they were to work as a professor, they would spend a great amount of time interacting with people, would receive a more moderate level of pay, and would spend negligible time interacting with things. Also, Abigail is modeled as finding only slight value from interacting with others, and instead most values environments where she is working with physical objects and receiving a high salary. In contrast, Beatrice is modeled as placing only a moderate value on how much she is paid, but highly values environments where she is interacting with people, and has no preference for interacting with things.

Figure 1 show the four situations we can create from all combinations of these two people and jobs. After structuring the field by selecting a person and their job, we can set the level of the feature “ $At(Job)_p$ ” to 1 to imagine the person working at their selected job, and estimating their expected ultimate appraisal of this experience. The model indicates Abigail should appraise working as an engineer more positively than working as a professor, $[At(Job)_A \xrightarrow{.69} U_A]$ (Figure 1a) vs. $[At(Job)_A \xrightarrow{.38} U_A]$ (Figure 1c), and thus should be expected to choose the engineering position. The field model indicates the major reason for this is because Abigail believes working in industry will greatly increase the time spent working with things, which she prefers: $[At(Job)_A \xrightarrow{.8} With(Things)_A \xrightarrow{.4} U_A] = .32$ (Figure 1a) vs.

$[At(Job)_A \xrightarrow{.1} With(Things)_A \xrightarrow{.4} U_A] = .04$ (Figure 1c).

In contrast, Beatrice is expected to appraise working as an engineer considerably less positively than working as a professor, $[At(Job)_B \xrightarrow{.35} U_B]$ (Figure 1b) vs. $[At(Job)_B \xrightarrow{.78} U_B]$ (Figure 1d), and thus is

expected to choose the professor position. The model indicates the major reason for this is that Beatrice expects working as a professor to involve much more interpersonal interaction, which she strongly prefers:

$$\left[At(Job) \xrightarrow{.2} With(People) \xrightarrow{.7} U\right] = .14 \text{ (Figure 1b) vs. } \left[At(Job) \xrightarrow{.9} With(People) \xrightarrow{.7} U\right] = .63 \text{ (Figure 1d).}$$

This example details how functional field models can represent expectancy×value model dynamics, where an action’s ultimate appraisal (or *expected value*, *subjective expected utility*) is estimated as the sum of the action’s various expected effects on particular factors weighted by each factor’s value to the person (e.g., Ajzen & Fishbein, 2008; Feather, 1982; Hammond et al., 2002; Krantz & Kunreuther, 2007). This functional field model is otherwise extremely rudimentary and could be expanded in numerous ways. For instance, if we were a career counselor working with a specific client – perhaps *just* Abigail – we could evaluate the client’s fit on potentially *hundreds* of jobs that have been coded along the dimensions that the client values rather than just the two shown here – for instance, perhaps all of the occupations currently included within the current Occupation Information Network (O*NET, 2019). Conversely, if we were a hiring manager at a specific company – perhaps *just* the company trying to hire an engineer – then we could evaluate the potential fit of dozens or hundreds of applicants rather than just Abigail and Beatrice. The model could be expanded to accommodate other features of these jobs which form nontrivial and distinct reasons that people prefer certain jobs over others. And finally, the functional field model in Table 1 could be made more dynamic by detailing how Abigail’s and Beatrice’s preferences are expected to vary across different situations. For instance, perhaps both women would value money less if they had less college debt; the level of the $[Money_p \rightarrow U_p]$ force could be modeled as being a function of the person’s current level of money, $Money_{p(t)}$, as in marginal utility models (Diener et al., 2008; Layard et al., 2008).

Identifying the *Field Effects* (i.e., *Traits*) of a Particular Factor

Within functional field models, we can represent the way in which the level of factor j affects the larger situation s_t as $F_{p(j,t)}$, which describe the *field effects of factor j given conditions t* . The estimated field effects $F_{p(j,t)}$ are understood as a formal representation of p 's beliefs regarding the *traits* of factor j , where t specifies the range of situations that these traits can be expected to generalize to. This follows from the understanding of the *traits* of a person, place, or thing as anything that describes their characteristic *expected effects on a situation when present* (Wiggins, 1997; Wood, Tov, et al., 2015).³

We can index the traits of any factor in this manner – such as the *hardness* of a rock, the *sourness* of a lemon, the *beauty* of Paris. However, the most important factors of human environments are generally other people (Buss, 1996). We can denote *interpersonal perceptions* as $F_{p(p',t)}$ to indicate how person p perceives the traits of another person p' in situations t . And likely the most important interpersonal perception is a person's own self-perception (Hofstadter, 2007), which we can denote as $F_{p(p,t)}$.

The field effects of a particular factor can be estimated via a *model-based* or *experiment-based* strategy, as described below.

Model-Based Estimation of Field Effects

The *model-based* method simply involves inspecting the formulas within the functional field model F_p to find where factor s_j is represented. Any formula containing s_j indicates a place where the level of the factor affects the level of a force within the field, and all the remaining parts of the formula indicate conditions that will make the factor's effects larger or smaller.

For instance, we might see that in model F_p (usually: our model of how person p understands their environment), the formula $(.7s_j \times s_m) \rightarrow f_{XY_{p(t)}}$ sets the expected level of force of X on Y . The formula reveals that if the level of some other feature s_m is 0 (e.g., condition s_m is “not true” at time t), then altering the level of s_j will not have any effect on the force X is expected to exert on Y , but that if s_m is 1 (e.g., the

condition is “true”), then increases in the level of s_j may have fairly large effects on the level of this force. In essence, having access to the formulas comprising the functional field allows us to estimate $\mathbf{F}_{p(j,t)}$ detailing the field effects of j for any conditions t we may wish to specify.

As this example indicates, the value of model-based estimates of a factor’s effects on the field, $\mathbf{F}_{p(j,t)}$ depends greatly on the quality of the larger model $\mathbf{F}_p$. Once we have a well-developed model of the person – perhaps analogous to someone’s model of their romantic partner after years of thoughtful observation – we can make good predictions of how the presence of the person will structure a wide range of different situations. But the predictions made from less developed models will be less valid and useful.

Experiment-Based Estimation of Field Effects

The *experiment-based* method for estimating a factor’s field effects parallels empirical methods of estimating a factor’s causal effects within the literature in causal inference (Novick & Cheng, 2004; Pearl, 2009),⁴ where we estimate the structure of the field holding all situational states constant at level t except for the factor j :

$$\text{Equation 2. Field effects of factor } j \text{ at level } c \text{ vs. } c' \text{ in situation } t. \mathbf{F}_{p(\Delta j,t)} = \left(\mathbf{F}_{p(t,j=c)} - \mathbf{F}_{p(t,j=c')} \right)$$

This can be used to compare how field structures differ across levels of factor j , whether j is a continuous variable (e.g., *tip given* = 15% versus 20%), categorical variable (e.g., *person hired* = *Abigail* versus *Beatrice*), or dichotomous variable (e.g., *have insurance* = *true* (1) versus *false* (0)).

The experiment-based method to estimating field effects is more crude than the model-based method described earlier, but often necessary, because good specifications of the formulas within $\mathbf{F}_p$ which determine the structure of the field at a given time, $\mathbf{F}_{p(t)}$, are very frequently unavailable – particularly in the early stages of developing a model of how the person processes situational information. But the method is also very useful; as noted by Cheng (1993, p. 255), “by the manipulation of a target factor

independent of other factors, we can isolate the influence of that factor. The beauty of independent manipulation is, of course, that other factors can be kept constant without their being identified“ (p. 255). Indeed, is it through conducting experiments – placing the person in situations, and then observing how they perceive the consequences of responding in different ways, and how they ultimately respond – that better functional field models of the person’s psychological processes (i.e., better specifications of $\mathbf{F}_p$) can be progressively constructed. As Cheng also indicates, however, the drawback of this method is that by only estimating the factor’s effects within the range of situations defining t , the estimates may not adequately characterize the factor’s effects in other situations that may be of interest.

Estimating a factor’s field effects through *elaborated situational judgment tests* (ESJTs). One way the field effects of a particular situational factor can be empirically estimated is through *elaborated situational judgment tests* (ESJTs). These operate largely in the same manner as conventional situational judgment tests (SJTs; see Lievens, Schäpers, & Herde, this volume), where participants usually are presented with a hypothetical situation, imagines two or more actions they could perform in this situation, and are asked which action they would be most likely to perform. In an ESJT study, participants are additionally asked to rate the *expected effects* of performing each action on specific features of the situation – which can range from *other people’s well-being* to *the quality of one’s relationship with the people involved*.

An example adapted from ESJT scenarios used by Wood et al. (2017) and Lowman et al. (2020) to understand how people might respond to workplace interactions involving a coworker is given in Table 2. As described in further detail in those articles, it is possible to estimate field models empirically using the standard methods of path analysis or structural equation modeling. In essence, ESJT data can be used to estimate an *expectancy matrix*, $\mathbf{E}_{p(t,i)}$, with cells $e_{jj'}_{p(t,i)}$ detailing how persons p expects outcomes j and j' to covary when performing actions i in situations t . Then, in the same way that we can fit a path model (a

beta matrix) $\mathbf{B}$ of the causal relations that could account for the observed correlation matrix $\mathbf{R}$, we can fit a field matrix as a model of the forces $\mathbf{F}_{p(t,i)}$ that could account for the observed pattern of covariation within the observed expectancy matrix $\mathbf{E}_{p(t,i)}$.

As indicated in Table 2, ESJTs provide a clean means of differentiating *situation*, *action*, and *person*-related factors. *Situation* factors concern anything that causes expected outcome ratings to vary as a function of the scenario, $\mathbf{t}$, presented to participants. This could involve how the structure differs across entirely different scenarios, or by varying a more particular factor within a given scenario. For instance, is the coworker within the scenario described as being the participant's *subordinate* or their *manager*? *Action* factors concern anything that causes the participant's expected outcome ratings to vary as a function of the *action*, $\mathbf{i}$, being considered as a response to the scenario. In this example: do you *agree to help the coworker*, or *decline their request*? And *person* factors concern anything that causes expected outcome ratings to vary as a function of the *person*, $\mathbf{p}$, who is responding to the scenario. For instance, is the person completing the test *agreeable* or *disagreeable*? Or *male* or *female*? In each case, we can use Equation 2 to estimate field effects by seeing how $\mathbf{F}_{p(t,i)}$ matrices differ across levels of the situation, action, or person factor while holding all other factors constant.

Estimating effects of situational factors, $\mathbf{F}_{p(\Delta j, t, i)}$. We can estimate how varying a particular feature within a scenario presented to participants alters their intended behavior by estimating how it alters their understanding of the situation, as represented via field models. For instance, Lowman, Wood, and Harms (2020) presented participants with scenarios describing coworker interactions like those shown in Table 2, but where for each participant the phrase “*your coworker*” was replaced with either “*your manager*” or “*your subordinate*.” This allowed examination of how participants expected their coworker's level of formal power to affect otherwise identically described situations. Figures 2a and 2b provide field models fitting how participants described the expected effects of expressing disapproval toward their *manager* versus

their *subordinate*, respectively. Following Equation 2, Figure 2c displays the simple difference between these models.

As Figure 2c shows, the structure of the field differed fairly negligibly as a function of whether participants imagined interacting with a manager or subordinate, indicating that participants *mostly* perceived the consequences of expressing disapproval to a coworker similarly across this condition. However, there was one force that differed across these conditions fairly dramatically. Part of the larger pathway involving the differing force is extracted from the three diagrams and given below:

(2a) $F_{p(\text{Co}=\text{Manager})}$:	$[ExpDisapproval(Co)_p \xrightarrow{-.74} IntQuality(Co)_p \xrightarrow{.84} RelQuality(Co)_p \xrightarrow{.33} JobSecurity_p]_p$
(2b) $F_{p(\text{Co}=\text{Subordinate})}$:	$[ExpDisapproval(Co)_p \xrightarrow{-.64} IntQuality(Co)_p \xrightarrow{.78} RelQuality(Co)_p \xrightarrow{-.10} JobSecurity_p]_p$
(2c) $F_{p(\Delta Co)}$:	$[ExpDisapproval(Co)_p \xrightarrow{-.12} IntQuality(Co)_p \xrightarrow{.08} RelQuality(Co)_p \xrightarrow{.43} JobSecurity_p]_p$

The differing force is outlined in a box within the table above. Specifically, participants believed that the quality of their relationship with the coworker (“Co”) would have a *much* larger effect on their own job security if their coworker was their *manager* than if the coworker was their *subordinate* (i.e.,

$$[RelQuality(Co)_p \xrightarrow{+.43} JobSecurity_p]_{p(\text{Manager}-\text{Subordinate})}; \text{ Figure 2c}.$$

As the larger pathway indicates, in both conditions (Figures 2a and 2b), participants tended to believe that expressing disapproval with their coworker’s actions within these scenarios would have a strong negative effect on the quality of that interaction with the coworker, which in turn would translate into a strong effect on the quality of their larger relationship. However, if the coworker was one’s *subordinate*, this was essentially the end of the consequences – one’s relationship with the coworker was expected to have a negligible effect on one’s own job security. By multiplying the forces on the path in

model 2a, we obtain $(-.64) \times .78 \times (-.10) = .05$ as indicating a trivial total effect of expressing disapproval on one's job security through this pathway. However, if the coworker was one's *manager*, the quality of the relationship with the coworker was expected to have a much larger effect on one's job security, making the total negative expected effect of expressing disapproval on one's job security non-trivial – i.e., $(-.74) \times .84 \times .33 = -.21$.

This result is consistent with the theoretical understanding of how one's level of power affects assertive and expressive behavior. Specifically, interacting with a higher power person is expected to decrease assertive behavior by increasing the expectation that expressing your thoughts or feelings will lead to punishment (Ames, 2008; Keltner et al., 2010; Wood & Harms, 2017). This example illustrates how this understanding can be formally represented within empirically estimated field models.

Estimating action effects, $F_{p(\Delta i, t)}$. We can also estimate *action effects* by examining how field structures differ when performing different actions i and i' . For instance, $F_{p(\Delta i, t)} = (F_{p(t, i)} - F_{p(t, i')})$ would estimate “how would situation t differ by doing this action i versus doing this other action i' ?”

Wood, Tov, and Costello (2015) used a variant of this method to examine differences in the expected effects of actions characterized as high or low on abstract terms such as *kind*, *assertive*, *cooperative*, *industrious*, and so on. Specifically, they had raters describe the expected effects of performing different actions and were able to show that the abstract characterizations of these actions were often very highly correlated ($r_s > .70$) with the degree to which actions were expected to have certain types of effects – i.e., with $[i \Rightarrow X]$ expectancies. A number of the stronger associations found in this study are represented graphically in Figure 3. For instance, an action was much more likely to be characterized as *kind* if it was expected to increase others' well-being, *assertive* if it was expected to increase the *expression of the individual's beliefs or desires*, and *dependable* if it was expected to increase the likelihood of *fulfilling one's commitments*.

Estimating person effects, $F_{\Delta p(t,i)}$. Finally, we can use ESJTs to estimate *person effects*, by estimating how different types of participants describe the effects of performing the same actions in the same situation, $F_{\Delta p(t,i)} = (F_{p(t,i)} - F_{p'(t,i)})$. For instance, Wood et al. (2017) examined how people high and low on a scale of “dark” (i.e., psychopathic, narcissistic, and Machiavellian) tendencies differed in perceiving the type of workplace situations presented in Table 2 and Figure 2, and found evidence that dark individuals placed less priority than most people on a sense that they had *acted appropriately* when selecting actions, i.e., the $[ActedAppropriately_p \rightarrow U_p]$ force was lower.

This method can also be used more generally to explore how people high or low on levels of any trait differ in their construals of the same situations. For instance, Wood and colleagues (2015) used this method to provide evidence that a particular abstract trait term generally provides complementary information when used to describe *people* versus when used to describe *actions*. As shown in Figure 3, whereas a particular *action* characterization (e.g., “that was an *assertive* action”) largely concerned the likelihood that the action will increase a particular outcome, or $[i \Rightarrow X]$ expectancies, the same *person* characterization (e.g., “she is an *assertive* person”) largely concerns the likelihood that a person will more positively appraise situations with higher levels of the same outcome, or $[X \Rightarrow U_p]$ valuations. For instance, as shown in Figure 3, we are likely to characterize an *action* as being *kind* if performing the action is expected to improve other’s well-being, $[i \Rightarrow WB_{Others}]$, but we are likely to characterize a *person* as being *kind* if they tend to prefer actions expected to improve other’s well-being $[WB_{Others} \Rightarrow U_p]$. In other words, we can understand an *action* characterization and its corresponding *person* characterization as concerning major sources of the *expectancy* and *valuation* for the same outcome, respectively.

These methods provide a useful tool for elaborating a perspective on the relations between personality traits and actions dating back to Aristotle (trans. 1962), who said “we become *just* by the practice of just actions, *self-controlled* by exercising self-control, and *courageous* by performing acts of

courage,” and more recently as understanding that people have higher trait levels when they tend to perform more trait-identifying actions (Buss & Craik, 1983; Fleeson & Gallagher, 2009; Wood & Roberts, 2006). The methods for estimating field effects of actions and people described here adds an important piece to this understanding, by providing a means of identifying what types of situational effects people have in mind when they characterize an action or person as *just*, *self-controlled*, *courageous*, and so on. In essence, we can characterize *actions* by their expected effects (Wiggins, 1997; Wood, Tov, et al., 2015), and we can characterize *persons* by the same term when they can be shown to differentially select actions expected to produce those effects.

Representing Verbal Descriptions of Actions, People, and Situations within Field Models

The earlier examples have already introduced the idea that verbal descriptions of actions, people, and situational features can be represented within field models. This idea will now be developed more formally.

Verbal Statements as the Outcomes of Tests on the Person’s Mental Model of the World

The types of verbal statements people are asked to endorse in self-report questionnaires, or that people provide to describe aspects of their environment within casual conversation, can be regarded as the outputs of little tests on the person’s mental model of the world. For instance, if we ask someone “Do you like watching sports?”, this can be understood as asking the person to run a so-called ‘low-fidelity simulation’ (see Lievens et al., this volume) of how they might respond to watching sporting events – maybe by imagining themselves as watching a baseball or football game in person or on TV – and reporting back to us whether they would find this simulated experience satisfying. These are regarded as ‘little tests’ or ‘low-fidelity simulations’ mainly to indicate that people routinely are able to provide consistent reports regarding the degree to which such statements are true or false in a survey within the span of a couple seconds (e.g., Wood, Harms, Lowman, & DeSimone, 2017).

The tests that are relevant to determining whether a verbal statement is valid or invalid can be represented more formally using the equations below:

Equation 3a: Test conditions for larger verbal statements: $(F_{p(v)} \in B_{p(v)}) \rightarrow v_p$

Equation 3b: Test conditions for short verbal phrases: $\left[X_v \xrightarrow{\in [LB_v, UB_v]} Y_v \right]_{p(s_v)} \rightarrow v_p$

The left-side of the equation indicates the more specific *test functions* which formally represents the *meaning* of a verbal statement a person might make, v_p , on the right. Equation 3a indicates person p can validly make statement v_p if they believe that the level of forces implied by the verbal statement, $F_{p(v)}$, are within boundaries $B_{p(v)}$. Equation 3b indicates that the more molecular *phrases* which combine to form the larger representation of the verbal statement $F_{p(v)}$ can generally be usefully understood as concerning whether the total force that a single feature exerts on another in relevant conditions is within the phrase's indicated boundaries $\left[X_v \xrightarrow{\in [LB_v, UB_v]} Y_v \right]_{p(s_v)}$. The consistent v subscripts indicate that the verbal phrase contains everything the person needs to run the relevant test: its qualifying conditions (s_v); the situational factors that define the relevant force (X_v and Y_v); and this force's bounds (LB_v and UB_v) – whereas the p subscript in this notation indicates that ultimately a verbal statement is made by and interpreted by people, and its meaning and validity is thus ultimately determined within the mental model of the person interpreting the statement (Kelly, 1963).

Table 3 illustrate a broad assortment of verbal statements which can be represented in this manner.⁵ The most general verbal statement of a test function in the form given in Equation 3b might approximate Example #0 in Table 3: “In situation s_v , the total effect of X on Y is between LB and UB ” Although we should be able to replace all the variables in this statement with more specific referents to make a statement that makes sense, people usually find they can communicate the same information

through more compact verbal statements. For instance, this more specific formalism is given for Example #1 in Table 3:

$$\left[\textit{Watching}(\textit{Sports})_p \stackrel{\in[.1,1]}{\Longrightarrow} \textit{Satisfied}_p \right]_p$$

Note that the conditions for this test function is omitted – i.e., the more general $p(s_v)$ notation is reduced to just p – to indicate this formalism is about how p understands the nature of this relationship “in general.”

We can plug the various components of this example into the relevant places for the general verbal statement given above to produce this statement: “In general, the total effect of watching sports on my level of satisfaction is at least slightly positive.” However, most people will find they can communicate largely the same information through the more compact statement “I like watching sports.”

As Equation 3b indicates, there are many different components that go into translating a verbal statement into a test function or vice versa. Varying a single one of the elements of a particular test function can result in a great diversity of different verbal statements, as elaborated below.

Modifying boundary conditions of the same force. The examples given in rows #2-11 within Table 3 illustrate that we can modify the *bounds* within a particular test function to make different statements regarding the *level* of the relevant force. For instance, we can shift the lower bound of statement #1 upward from $[.1,1]$ to $[.5,1]$ to communicate that the person doesn’t just “*like* watching sports,” but rather that the person “*loves* watching sports!” These sort of extremity modifiers are regularly used within psychological assessments, such as to better triangulate a person’s trait level within item-response theory (Chernyshenko, Stark, Drasgow, & Roberts, 2007; Fraley, Waller, & Brennan, 2000). For instance, a person might agree with the statement “I *like* watching sports” (#1 in Table 3) but disagree with the statement “I *love* watching sports” (#2). If we trust these formalisms, this would indicate that the person is describing

their level of this trait as in the range of $[.1, .5]$ – i.e., high enough to pass the lower bound for *liking* watching sports but not high enough to pass the lower bound for *loving* it.

The final examples in this first group of statements indicate how we can formally represent the meaning of statements which concern how the person’s level of a trait compares to other people’s level of the same trait (#8-10), or how it compares to the person’s level of a different trait (#11). These indicate how we can represent survey questions which more directly ask how a person’s level of a trait differs from some comparison group (e.g., Biernat, 2003; Kruger & Dunning, 1999), or *forced-choice* or *ranking* questions which ask for the person to compare their levels of different traits against each other (e.g., Block, 1961; Heggstad, Morrison, Reeve, & McCloy, 2006).

Modifying test conditions of the same force. Research using experience sampling methodologies demonstrate that a person’s trait levels vary meaningfully across situations (e.g., Ness & Heggstad, this volume; Zayas, Shoda, & Lee, this volume), and that people often have some awareness (or at least theories) of the conditions in which their trait level is higher or lower (e.g., Wood & Harms, 2017). For instance, the person might agree with the original statement “I like watching sports”, but also understand that there are certain conditions where this is more true than others. Perhaps the person enjoys watching sports more when with their spouse Tom, which could be indicated by the person agreeing with statement #11 but not #12. These more conditional or contextualized traits can be indicated by sneaking “*when*” modifiers into a more general statement (e.g., “how responsible are you *when at work*?” (Bing et al., 2004; Ching et al., 2013; Wood & Roberts, 2006).

Condition modifiers can also be used to more directly indicate the “active psychological ingredients” (Mischel & Shoda, 1995, p. 255) affecting a person’s trait levels. A statement “I like watching sports *more when I’m with Tom*” (#13) can be regarded as more directly indicating an aspect of Tom’s *field effects* as understood by the person, $F_p(\Delta T_{om}, t)$, as represented earlier in Equation 2. We can picture the

person as imagining watching sports in situations where Tom is present or absent, and reporting that their satisfaction from sports-watching was higher when he was present.

Modifying test factors to test different forces. The final examples in Table 3 illustrate how the X and Y features within the generic test function can be altered to correspond to different traits. Whereas the first two groups mostly concern altering magnitudes or conditions of the same trait, these final examples more directly correspond to making statements about different types of traits. Examples #14 and #15 illustrate that we can alter X and Y to represent statements about how the person understands the same trait in *other people* rather than oneself. Example #16 illustrates we could also make statements about how *other people* gain satisfaction from *you* doing an activity, which are similar to survey items asking the person to indicate whether they feels social pressures to perform certain actions (e.g., Ajzen, 1991; Cialdini & Trost, 1998).

We can also modify the test function to represent liking a more specific class of activities within the broader class (e.g., liking *watching baseball* rather than *watching sports in general*, #17), or different activities entirely (#18-19). And the final three examples (#20-22) illustrate how we can represent statements about different types of outcomes that could result from the same activity. For instance, instead of asking the person to imagine how watching sports impacts their sense of satisfaction (#1), we could ask the person whether they believe it impacts their relationship with important people in their life (#20) or is useful in advance other goals (#21).

More general test forms. More generally, common short verbal phrases that people give to explain their actions, or which are found regularly in questions within psychological surveys, can be reasonably well-represented as generic test forms, in which most of the properties of the more general test function given in Equation 3b are prespecified. A small set of more generally useful phrases which people might provide when describing reasons for performing certain actions, and which will be commonly found in the types of items used in personality questionnaires and other psychological surveys, is given in Table 4. For

instance, we might regard a statement like “ p likes X ” to fit the general function: $\left[X \xRightarrow{\in[.1,1]} Satisfaction_p \right]$,

where we can replace the X in this test form with virtually any feature in the environment, as shown in examples #17-19 in Table 3, to achieve a reasonably good formalism of the statement. Similarly, verbal statements taking the form “I find it useful to X ” might be represented by the generic test form

$\left[X \xRightarrow{\in[.1,1]} IU_p \right]$, with IU serving as an abbreviation for *instrumental utility*, indicating, roughly, the person’s

belief that the level of X promotes the attainment of other valued goals.

Formally representing abstract trait terms. Abstract trait terms – such as whether a person is *cooperative*, *trustworthy*, *selfish*, or *extraverted*, *agreeable*, *conscientious*, *neurotic*, *open* or *intelligent* should be representable in precisely the same way as the longer verbal phrases described above (Equation 3a-b). A useful means of understanding how abstract trait terms might be represented as formal test functions is consequently to find longer verbal statements of their meaning in the form of dictionary definitions. Often, these definitions will resemble the generic statements given in Table 4. For instance, saying a person is *sociable* can be understood as saying the person is “*inclined to seek or enjoy companionship*” (Merriam-Webster, 2020), which may indicate a formalism such as $\left[With(Others)_p \xRightarrow{\in[.1,1]} U_p \right]$ or

$\left[With(Others)_p \xRightarrow{\in[.1,1]} Satisfied_p \right]$.

The Value of Trait Information

It is useful to note that the major components needed to specify a trait’s test function (i.e., the X , Y , and t components in Equation 3) are *categories*, or sets containing a large number of members meeting certain inclusion rules. For instance, in the examples given in Table 3, the set of situations which most people might regard as valid instances of “watching sports” might include watching any NFL, NBA, MLB, NHL, and MLS game, their minor league equivalents, college games, high school games, the Olympics, and

so on. Understanding what people regard as valid members of the category helps to understand the verifiability and value of traits. For instance, if a person were to watch a basketball game on television and we had a valid measurement of whether they enjoyed watching the game, this would constitute an observation we would probably regard as appropriate for helping to establish whether the person *actually* likes watching sports.

The value of trait information becomes clearer as we understand traits as “situation-equivalence classes” (Allport, 1937; Funder, 1991) in this manner, and that a given person will often be in many situations relevant to a particular trait through the course of a day. For instance, in a single day, a particular student, Jane, may encounter assertiveness-relevant scenarios ranging from (1) *whether to draw attention to an error she noticed her professor make in her large lecture class*, to (2) *whether to state her true preference to eat Chinese food for lunch when she thinks all her friends want to eat Italian*, to (3) *whether to request her harried waiter bring her a preferred blend of 90% unsweetened tea and 10% sweet tea*, to (4) *whether to express her controversial political views with non-like-minded peers*, to name just a few. The decision to do each action might qualify as having performed an *assertive* action of the sort represented in Figure 3 – i.e., *doing an action that is expected to better express one’s beliefs*, and particularly when doing so might lead to negative interactions or consequences (Ames, 2008; Wood, Tov, et al., 2015). If we are told that Jane “*is really assertive*”, this can be taken as indicating that when Jane is considering how to respond in a given situation, she tends to select her course of action by placing considerable weight on expressing her beliefs and desires– e.g., $\left[\textit{ExpressedSelf}_{\textit{Jane}} \xrightarrow{\in[.5,1]} U_{\textit{Jane}} \right]$. We can use this piece of information to adjust our expectation (in Bayesian terms: ‘update our priors’; Holt & Smith, 2009) upward that Jane will do the actions described above and others like them. Conversely, if we see that Jane does *not* choose the

more assertive ways to respond to the situations above, this would create a strong evidentiary record that Jane is not in fact “really assertive” – that perhaps such a trait attribution is *wrong* or *inaccurate*.

More generally, the recognition that trait information concerns how a person is likely to alter or respond to their environment is a crucial part of what makes trait information *useful to know* (Buss, 1996; Funder, 1991). Returning to the example in Table 3, having on good authority that a person *likes watching sports* (#1) – and perhaps *likes watching baseball* (#17) in particular – could be a useful bit of information to know when determining where you might take that person on a date to share an enjoyable time. More generally, accurate trait information is useful for anticipating how the person will respond to different situations, which is valuable for determining how (or whether) to interact with the person (Cottrell et al., 2007; Wood, 2015)

Using Functional Fields to Represent Arguments about How Traits Relate to One Another

Some of the most interesting questions in psychology concern how different psychological variables, processes, or traits affect one another. Often, the evidence which initiates such questions is finding that the endorsements of verbal statements within scales used to operationalize traits *A* and *B* are highly correlated within some population *p* – e.g., $r(v_A, v_B) > .50$.

There are many different conditions which can lead scales to have high correlations with one another. First, a high correlation between scales *A* and *B* may indicate *semantic redundancy* or a *tautology* – basically what you would get from correlating scales “in which the same thing is said twice in different words” (OED, 2020). Many investigators argue that high correlations between scales of nominally different constructs are often due to semantic similarities in the items used to operationalize them (e.g., Arnulf & Larsen, this volume; Banks et al., 2018; Le et al., 2010; Möttus, 2016; Nicholls et al., 1982). Alternatively, the level of one psychological variable could *causally affect* the level of the other. For instance, the great interest in personality factors such as the Big Five or Five Factors is due in part to an understanding that

they approximate major *sources* of many other psychological and behavioral tendencies. As an example, McCrae and colleagues argue that *extraversion* is a ‘basic tendency’ which shapes many less ‘basic’ psychological and behavioral tendencies, ranging from tendencies to act in an *assertive*, *sociable*, and *active* manner, to more specific tendencies, such as the tendencies to *enjoy parties* or *attend parties* (McCrae & Costa, 2008; McCrae & Sutin, 2018; Safron & DeYoung, this volume).

As detailed below, field models can be useful for representing arguments about whether two or more traits have *semantically redundant* versus *causal relationships* with one another.

Representing Semantically Redundant Relationships

Representing two different verbal statements by an identical test function formally represents an argument that the statements may ‘mean the same thing’ or are semantically redundant. Conversely, if two verbal statements get at two different “nuances” of meaning, this understands that their test functions should be represented as being at least slightly different from one another, as it indicates there are conditions in which a person could validly agree with one statement, but not the other (Condon et al., in press). As an example, Row #1 of Table 3 indicates that the same test function could serve to formalize the statements “I like watching sports,” “I enjoy watching sports,” “I find watching sports satisfying,” and others. This serves as the functional field modeler’s version of the argument that these statements *mean the same thing* or *communicate the same information* (compare to Arnulf & Larsen; Condon & Möttus, this volume). Figure 3 also provides a couple of examples of terms which may have semantically redundant relationships with one another; these are indicated via forces that are labeled by multiple trait terms. For instance, we could discover that calling a person *outgoing* essentially communicates the same information to most English speakers as calling the person *sociable* and vice versa, with both ultimately indicating the degree to which a person selects actions expected to result in being in social situations, $[In(SocialEnv)_p \Rightarrow U_p]$ (Wood, Tov, et al., 2015). Similarly, calling someone *kind* may communicate largely redundant information

as calling them *caring*, with both terms indicating the degree to which a person factors in others' well-being in making decisions, [$WellBeing_{Others} \Rightarrow U_p$].

Note that empirical research could ultimately demonstrate that people in some population do *not* find these examples as communicating equivalent information. This could be demonstrated by identifying specific instances in which a person behaves or feels a certain way, which observers tend to reliably classify as being *kind* but not *caring* or vice versa. Such instances would allow us to better differentiate the test functions for the two traits.⁶ The more important argument is that traits or verbal statements should be regarded as redundant *if and only if* they have the same test function – that is: they communicate identical information about how the subject affects the structure of the environment when present.

This condition of two different statements having identical test functions is likely very rarely met. For instance, *none* of the various modifications of the statement “I like watching sports” listed in rows #2 through #22 of Table 3 would actually be considered *fully redundant* to the original statement given in #1, despite the fact that self-ratings of many of them would undoubtedly correlate very highly. This understanding is formally represented by the fact that every row has a different test function. More generally, different phrases or trait terms generally communicate at least slightly different nuances in meaning (McCrae, 2014; Möttus, 2016). This is partly *why* the various terms a thesaurus lists as ‘synonyms’ of one another continue to be used separately. When describing one another, people somehow understand that calling someone *outgoing* or *caring* is just a little more precise in communicating what they want to say than calling them *sociable* or *kind*.

Functional Relationships between Traits

An argument that the level of a first trait causally affects the level of a second can often be formally represented by showing that the test function defining the first trait concerns a force which can be represented ‘inside’ the test function defining the second. This ultimately is an application of the *mediation*

principle described earlier, whereby any particular pathway we might represent as $[X \overset{+}{\Rightarrow} Y]$ can be expanded to represent one or more of the specific mediating pathways, $[X \overset{+}{\Rightarrow} M \overset{+}{\Rightarrow} Y]$. This idea can be used to represent arguments about how certain psychological processes or traits may be more basic causes of another.

Example 1: Why do you watch sports? First, it is possible to construct a field model in which many of the statements given in Table 3 are used to represent a person's *reasons* for watching sports, but also the *reasons for these reasons*, and so on. For instance, if a person says they tend to watch a lot of sports, we might ask: why? The person may reply, "I actually don't particularly like watching sports [statement #4 in Table 3], but I find watching sports useful" [statement #21]. Like our proverbial curious-if-somewhat-obnoxious child, we can ask again, why? The person may reply "because it helps the quality of my relationship with my husband Tom" [#20]. And again, why? The person might reply "because Tom likes it when I watch sports [#16]." We can pause this exercise here to represent the larger account the person has provided thus far for why they tend to watch sports as involving this larger pathway:

$$[Watch(Sports)_p \overset{+}{\Rightarrow} Satisfied_{Tom} \overset{+}{\Rightarrow} RelQuality(Tom)_p \overset{+}{\Rightarrow} IU_p \overset{+}{\Rightarrow} U_p]$$

This indicates that the tendency described by statement #21 is affected (mediated, caused, explained) in part by the tendency described by statement #20, which in turn is affected in part by the tendency described in statement #16. Our litany of whys could continue if we were interested in further "drilling down" into the reasons this person expects certain consequences to follow from watching sports, or from the various other outcomes resulting from it.

Example: She's *unsociable* because she's *shy*. As another example, we could be told that "Abby is *unsociable* because she is *shy*." As indicated in Figure 4a, calling a person *unsociable* may imply that the person avoids situations involving other people, suggesting the test function

$\left[With(Others)_p \xrightarrow{\in[-1,-.1]} U_p\right]$. In turn, a *shy* person is defined as someone who “is nervous and uncomfortable in the company of other people” (Collins Dictionary, 2020) suggesting a test function of a *shy* person as $\left[With(Others)_p \xrightarrow{\in[-1,-.1]} Safe_p\right]$, meaning the person believes that being around others may tend to decrease their safety.

Figure 4a illustrates how the test function for being *shy* can be represented as concerning the level of a force ‘inside’ the test function for being *unsociable*. More formally, Abby’s *shyness* produces an indirect negative effect for Abby where imagining being around people is appraised negatively because it decreases the sense of safety that she (like most people) strongly desires, forming a coherent *reason* for her *unsociable* behavior. The remaining direct path linking being near other people to her ultimate appraisals of the situation within Figure 4a indicates that there could be further unrepresented reasons why Abby is inclined toward or away from being with people, which could be explicitly represented in a more elaborated model.

Example: “You can’t like parties if you don’t like people.” As another example, Cramer and colleagues (2012) offer the statement “you can’t like parties if you don’t like people” as illustrating “semantically ‘logical’ dependencies” that can exist between psychological tendencies, something like the syllogisms found in philosophy (e.g., ‘Socrates is a human; all humans are mortal; therefore, Socrates is mortal’). The strategies detailed here show how these types of ‘semantically logical dependencies’ can be formally represented within a field model. As shown in Figure 4b, we can represent *liking parties* as concerning the force $\left[At(Party)_p \Rightarrow Satisfied_p\right]$, and *liking people* as concerning the force $\left[With(People)_p \Rightarrow Satisfied_p\right]$. If we just add one missing piece of information – an understanding that being at a party typically means you will be around people, e.g., $\left[At(Party)_p \xrightarrow{\in[.8,1]} With(People)_p\right]$ – we can show how *liking people* is likely to facilitate *liking parties*.

As in the previous example, an additional direct force is specified as linking being at parties to satisfaction, which indicates that in contradiction to Cramer and colleagues' original statement, a person *could* have coherent reasons for liking parties despite disliking people. For instance, the person might say "I really don't like people, but I love parties anyway, because by going to parties I get to eat those amazing finger sandwiches you just can't get anywhere else." We could represent this through a more elaborated field model which details that for this person, a strong positive

$[At(Party)_p \xrightarrow{+} Ate(FingerSandwiches)_p \xrightarrow{+} Satisfied_p]$ pathway creates a reason for liking parties,

which swamps the negative pathway formed from being around people. Of course, there are plenty of less silly reasons a person could provide for liking parties despite not liking people – for instance, the person might love certain activities which occur more regularly at parties (e.g., good music, dancing, drinking, raffles, charades) – which could be formally represented within field models.

Representing Sources of Trait Covariation

This understanding of how one trait may shape the level of another can be easily generalized to show how a single trait can be formally posited to affect *multiple* other traits. Specifically, we can understand multiple distinct psychological or behavioral tendencies as covarying because they share one or more forces within the larger pathways affecting the total force which defines the trait. A shared force of this sort will function as a *source trait*, serving to shape the levels of multiple conceptually distinct traits simultaneously.

The case of callousness. One of the central observations which led to the recent widespread interest in the 'dark' traits of psychopathy, Machiavellianism, and narcissism has been the finding that scales of these three traits tend to be moderately positively correlated, with correlations usually ranging from about .25 to .50 (Paulhus & Williams, 2002). This has been generally understood as indicating that these three traits, while conceptually distinct, are affected by common causes. Paulhus and Jones have

argued that *callousness* may serve as the psychological ‘core’ of these more specific dark tendencies (Jones & Figueredo, 2013; Paulhus, 2014). Figure 5a offers the conventional representation of how *callousness* serves this role. Specifically, some hypothetical variable we might call *callousness* is modeled as affecting the measured levels of psychopathy, Machiavellianism, and narcissism, such that after controlling for this variable the partial correlations between these traits are reduced to a level much closer to zero.

This can be contrasted with Figures 5b and 5c, which illustrates how Paulhus’ and Jones’ argument can be represented within field models. As shown in Figure 5b, we might understand the test functions defining *psychopathy*, *Machiavellianism*, and *narcissism* as involving the degree to which a person likely does actions expected to result in *physically harming*, *deceiving*, or *demonstrating their superiority* to other people, respectively. These particular representations are suggested through items used to operationalize levels of these traits, such as “It bothers me to see children or animals in pain [reverse-scored]” on psychopathy measures (Paulhus et al., 2009), “Never tell anyone the real reason you did something unless it is useful to do so” on Machiavellianism measures (Christie & Geis, 1970), and “I like to have authority over people” on narcissism scales (Ames et al., 2006; Raskin & Terry, 1988), respectively. If these serve as useful approximations of the test functions central to defining these three traits, we should find that individual differences in the levels of these three test functions are correlated – for instance: people who are more inclined to perform actions that *physically harm* others tend to be more inclined to perform actions that *deceive* or *demonstrate superiority over* others. Such a finding would recapitulate the ‘positive manifold’ that inspired much of the interest in ‘dark’ characteristics, but with the traits now represented as forces within field models of a person’s decision-making processes.

Observing that these action tendencies are correlated in this fashion could lead us to posit that these tendencies covary due to facilitating a common outcome that people value to varying degrees. As shown in Figure 5c, all three of these outcomes – having *physically injuring*, *deceiving*, or *dominating others*

– can generally be expected to negatively affect *others' well-being*. That is, we can think of these as three distinct ways a person can *decrease other's well-being* – i.e., as three more specific *X*'s we can use to fill this equation, $[X \xrightarrow{+} WellBeing_{other}]$, which can be described as *different types of things that tend to hurt people*. In turn, we can regard *callousness* as “a lack of concern or remorse for the well-being of others” (Jones & Figueredo, 2013, p. 522), or as “feeling or showing no sympathy for others” (Merriam-Webster, 2018), which could be formally represented as a test function such as this:

$$[WellBeing_{others} \xrightarrow{\in [-1,0]} U_p] \rightarrow “p \text{ is callous}”$$

Meaning: we can call a person *callous* if the expected effect of others' well-being on the person's motivation to perform the action is less than or equal to zero.

The field model given in Figure 5c illustrates how this conception of *callousness* can be modeled as a true source of *psychopathy*, *Machiavellianism*, and *narcissism* in the manner suggested by Jones & Figueredo (2013) and Paulhus (2014). Since people usually have *some* regard for other's well-being – i.e., the level of $[WellBeing_{other} \Rightarrow U_p]$ force appears to usually be positive for most people (Bowles & Gintis, 2011) – causing a person to *care less* about others' well-being should serve to increase all of these types of actions simultaneously, by eliminating a major reason people tend to avoid them. And conversely, causing a person to *care more* about others' well-being should cause the person to decrease all of these ‘dark’ tendencies simultaneously. To reference some thought experiments in literature: we might find a way to cause some Grinch's small heart to ‘grow three sizes’ (Seuss, 2015), or subject some Scrooge to the sort of empathy-expanding interventions performed by the Ghosts of Christmas Past, Present, and Future (Dickens, 2006). Such ‘changes of heart’ should result in a person becoming less motivated to injure, deceive, or dominate others, for the common reason that the person has become more concerned with avoiding actions that *hurt* others – i.e., they have become less *callous*.

Applications to the Big Five and beyond. Arguments that structural factors are more basic causes of other behavioral and psychological tendencies can be modeled in the same manner, such as the understanding that a trait like *extraversion* could serve as a common calibrator of more specific traits like *assertiveness*, *activity level*, *sociability*, and other more specific goals, interests, beliefs, and skills (Cattell, 1945; McCrae & Costa, 2008b; McCrae & Sutin, 2018).

Similar to some other proposals in this volume (see Read & Miller, this volume; Safron & DeYoung, this volume), the most ‘basic’ aspect of most Big Five or Five Factor dimensions may be represented as a type of *value*, indicating the weight a particular outcome receives within a person’s ultimate appraisals of different actions. For instance, in Figure 6, *extraversion* is represented as a person’s total valuation of *stimulating environments*, $[StimulatingEnv_t_p \rightarrow U_p]$, a representation suggested by high-loading items like “[I] Love excitement” (Goldberg et al., 2006; Wilt & Revelle, 2015); and *openness to experience* is represented as a person’s total valuation of novel experiences, $[NovelEnv_t_p \rightarrow U_p]$, a representation suggested by high-loading items like “[I] Like to visit new places.” *Agreeableness* is represented here as concerning the person’s level of the same dimension as *callousness* in the previous example, $[WellBeing_{Others} \rightarrow U_p]$, on the basis of high-loading items like “[I] Sympathize with others’ feelings.” (Note that in this conception, *callousness* and *agreeableness* concern different boundary intervals on the same dimension, much as abnormal traits are sometimes discussed as being extreme variants of normal-range traits; Markon, Krueger, & Watson, 2005; Miller, Lyman, Widiger, & Leukefeld, 2001).

In Figure 6, the only major dimension *not* represented as a value is *emotional stability* (versus *neuroticism*). As noted by Wilt and Revelle (2015), few items with high loadings on this dimension indicate a person’s preferences or desires. Rather, the highest loading items regularly concern the frequency of negative experiences, such as the items “[I] Am easily hurt” or “[I] Am filled with doubts about things.” Consequently, emotional stability could concern an expectancy such as $[i \Rightarrow Safe_p]$, indicating that an

emotionally unstable person may be one who sees most of the possible course of actions they are considering, i , as being less safe and secure. In this conception: safety may be valued highly and about equally by both neurotic and non-neurotic people, as reflected in a normatively high level of the $[Safe_p \Rightarrow U_p]$ force; but more neurotic people may believe that their safety is more *vulnerable* or *at risk* than others. Such a belief could serve as a core of various more specific indicators of neuroticism; a person who understands that their safety is tenuous at best may feel more anxious and depressed, and could spend more time deliberating before making a decision, in search of the elusive action that would be sufficiently safe.

Figure 6 provides an example of how dimensions like the Big Five could function as basic tendencies shaping a wide range of behaviors. In the same way that a person's level of psychopathy, Machiavellianism, and narcissism may be commonly shaped by the degree to which the person's gives consideration to others' well-being (Figure 5), the model represented in Figure 6 could be elaborated to show how this representation of extraversion could serve as a common calibrator of more specific tendencies to be *active*, *sociable*, *assertive*, *adventurous*, and so on. Specifically, all of these could be understood as action tendencies which tend to increase a person's sensory stimulation in different ways (i.e., serve as different X 's which tend to have positive $[X \Rightarrow StimulatingEnv_t_p]$ paths for most people), such that valuing stimulation more would raise all of these tendencies simultaneously.

A final caveat is that the field model given in Figure 6 is intended to serve as suggestions of how particular traits within the Big Five framework could be represented within field models. Each Big Five trait domain subsumes many different distinguishable traits (Pytlik Zillig et al., 2002; Wilt & Revelle, 2015; Wood, Gardner, et al., 2015), and the present framework suggests that every distinguishable trait should be defined with a distinct test function within a field model. The broader point is that the best candidates for traits serving as *sources* or *more basic causes* of other traits will be those with test functions that can be

represented as describing a force ‘within’ the test functions representing other traits. This has been illustrated in this chapter by detailing how *shyness* can be defined within the function defining *unsociability* (Figure 4a), how *liking people* can be defined within the function defining *liking parties* (Figure 4b), or how *callousness* can be defined within the functions defining *narcissism*, *Machiavellianism*, and *psychopathy* (Figure 5c).

Some Broader Implications of Functional Field Models for Understanding Behavior

Action Selection is Situation Selection

Within a functional field model, when an individual is simulating the effect of performing different actions, they are simulating the effects of altering the factors present within their environment, which in turn alter the levels of forces. This is perhaps clearest in the first example provided, where simulating the effect of accepting different jobs was modeled as altering the expected experiences associated with subsequently *going to one’s job*, or the level of $[At(Job) \rightarrow X]$ expectancies (Figure 1). However, these ideas can be applied more generally to understand how people not only *react* to situations, but also *actively select* or *create* them. For instance, a person who understands their level of power as affecting their ability to safely express their beliefs and desires in the normative manner depicted in Figures 2a-c might not merely consider whether to act in an assertive or unassertive manner within a particular situation, but may also consider ways they could go about increasing their level of power in the future. For instance, an employee imagining how they might respond to a slight from a more powerful coworker might respond “I won’t say anything to this coworker *now*, but I will instead do everything I can to get promoted so that *I’m* their boss the next time something like this happens – and *then* I will let them know what’s on my mind!”

More generally, actions can be understood as performed to intentionally alter the structure of forces within the person’s environment to strengthen the pathways linking other actions to valued outcomes. For instance, a man might imagine nothing better than having a date with the woman he is

interested in, $[Dated(W)_M \xrightarrow{+++} U_M]$. However, if the man is scruffy and disheveled, and understands that she strongly prefers classy men who look the part, he might understand that asking her for a date right now has virtually no chance of securing that desired date $[AskedToDate(W)_M \xrightarrow{0} Dated(W)_M]$. If so, the man might decide to first start dressing in fancier clothes, spending more time grooming, and so forth, and *only then* asking for that date. Formally, we can understand that the actions performed prior to asking her for a date were performed to increase the level of the $[AskedToDate(W)_M \Rightarrow Dated(W)_M]$ force to a level sufficient that asking the woman for a date is an action actually worth attempting.

More generally, every day people will perform numerous multi-step action plans of this sort, where the final action only makes sense to perform after the earlier steps have been successfully executed (Jackendoff, 2009). Functional field models can help to understand the logic of these multi-action plans, by showing why the final action in the plan only becomes particularly functional to perform after the prior actions have restructured the forces within the environment in a way that should lead the final action to now produce a favorable result. This would be a useful avenue for showing how field models can be used to represent the logic implicit in goal hierarchies (Austin & Vancouver, 1996; Little, 2008) and in self-regulatory and planning processes more generally (Carver & Scheier, 1998; Denissen et al., 2013; Hennecke et al., 2014).

Q: Why Did They Do It? A: Why Don't You Just Ask?

Much of this chapter details how the answers people provide to questions like “why did you do that?” (e.g., Wood, Gardner, et al., 2015; Yang et al., 2014) or “what did you think will happen if you did this in this situation?” (Lowman et al., 2020; Wood, Lowman, et al., 2017) can be formally represented within field models as pathways the person understood as linking their possible actions to valued outcomes. The procedures described here for translating verbal reports into field representations and vice versa are

preliminary, but as they become better developed, they will clarify how verbal accounts of action can be utilized to better represent the psychological processes underlying behavior. This in turn could help to better utilize qualitative sources of information, such as interviews with highly successful job occupants describing how they navigated difficult situations on the job (Flanagan, 1954), or with criminals describing the reasons they decided to perform crimes (Douglas & Olshaker, 1999; Soltes, 2016).

Of course, for a wide range of reasons, a person's verbal statements are often inaccurate in describing their own beliefs. This is often due to a *lack of self-insight*, where the person is unable to consciously access the beliefs that most directly motivated their behavior (Kurzban, 2010; Nisbett & Wilson, 1977; Trivers, 2011; Wilson, 2004), or due to *deception* or *impression management*, where the person actually does have insight into the reasons for their behavior but has decided not to share them, and perhaps decides to describe some false ones instead.

It may consequently be best to understand a person's verbal statements as usually providing a *coherent* account of their reasons for an action rather than an *accurate* or *honest* one. A *coherent* explanation can be regarded as one that would provide reasons to perform the action *if true*, but which may not actually be true. For instance, a politician (P), might explain that they provided a large tax cut to their constituents (C), because the politician "cares about their well-being," which – if true! – would create a coherent reason for doing that action, as represented below:

$$\left[GaveTaxCut(C)_P \xrightarrow{+} WellBeing_C \xrightarrow{+} U_P \right]$$

However, in actuality the politician may know that he doesn't care a wit about his constituents' well-being,

$\left[WellBeing_C \xrightarrow{0} U_P \right]_P$, and knows that the *real* reason he provided this tax cut was because he thought it

would promote the (erroneous) belief that he cares for his constituents, which would help him secure the

constituent votes needed to stay in power. We can represent this *real* process motivating his behavior as concerning this pathway in a field model:

$$\left[GaveTaxCut(C)_P \xrightarrow{+} [CaresFor(C)_P]_C \xrightarrow{+} VotedFor(P)_C \xrightarrow{+} Has(Power)_P \xrightarrow{+} U_P \right]_P$$

More generally, it is possible to differentiate field models representing the *real* situation at a given time, F_t , a person's *beliefs* regarding that situation, $F_{p(t)}$, the person's *beliefs about another person's beliefs about the situation*, $F_{p(p'(t))}$, and so on, to help represent such processes. Such elaborations have mostly been avoided in this chapter, however a great number of concepts – particularly those dealing with *honesty* and *accuracy* – are only well-defined by understanding the degree to which the forces communicated as present within a person's verbal descriptions square with their own beliefs or with actual reality. And a great range of strategic behavior concerns a person's efforts to manage the beliefs *of others* (Schelling, 1960). For instance, in the politician example, the politician understands that getting his constituents to erroneously believe he cares about them is valuable for securing the votes he needs to stay in power.

Field models generated by translating a person's verbal descriptions can be particularly useful representations of the psychological forces which determined the person's actions when the person is speaking honestly and has insight into their psychological processes. These conditions are obviously not always met, but certain procedures – such as 'speak-aloud' protocols (Ericsson & Simon, 1984; Fox et al., 2011) and the removal of rewards or punishments for describing certain beliefs or reasons for action – improve the degree to which verbal reports can be regarded as trustworthy. But field models can also be useful when a person's verbal statements are *not* to be trusted, by detailing how they are inaccurate, and also why the person may have been motivated to misrepresent their beliefs or reasons for action.

Conclusion

This chapter elaborates on two major ways in which functional field models can be used to represent psychological processes. First, functional field models can be used to represent how the forces an individual perceives as present within the situation are produced from the presence of more specific factors, and how these forces form *reasons* to pursue or avoid different courses of action. Second, more detail is given for how verbal statements and trait attributions can be formally represented within field models. This provides a novel means for representing long-standing arguments regarding the causal dynamics existing between distinct traits, such as why a person's level of *callousness* or *extraversion* might shape their level of a broad range of other psychological or behavioral tendencies.

The current chapter can largely be considered as providing a roadmap for how the characteristics of people and situations may be represented in ways that can be integrated with rational actor or expectancy-value-type models of behavior (Feather, 1982; Gintis, 2009; Hastie & Dawes, 2010). There remains much to do to develop this line of research. Further work utilizing elaborated situational judgment tasks (ESJTs; Lowman et al., 2020; Wood, Lowman, et al., 2017) in particular will be valuable for showing how field models can be created using participant data, for refining our formal representations of traits and verbal statements, and for understanding how people's actions are shaped by their own traits and by other factors present in the situation. As this program of research proceeds, functional field models may offer a particularly promising framework for representing how person and situation factors interact to determine a person's behavior, and for representing the psychological processes underlying behavior more generally.

References

- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179–211.
- Ajzen, I., & Fishbein, M. (2008). Scaling and testing multiplicative combinations in the expectancy–value model of attitudes. *Journal of Applied Social Psychology*, 38(9), 2222–2247.
- Allport, G. W. (1937). *Personality: A psychological interpretation*. Holt.
- Ames, D. R. (2008). Assertiveness expectancies: How hard people push depends on the consequences they predict. *Journal of Personality and Social Psychology*, 95(6), 1541–1557.
- Ames, D. R., Rose, P., & Anderson, C. P. (2006). The NPI-16 as a short measure of narcissism. *Journal of Research in Personality*, 40(4), 440–450.
- Ariely, D. (2008). *Predictably irrational*. HarperCollins New York.
- Aristotle. (1962). *Nicomachean ethics* (M. Ostwald, Trans.). Bobbs-Merrill.
- Austin, J. T., & Vancouver, J. B. (1996). Goal constructs in psychology: Structure, process, and content. *Psychological Bulletin*, 120(3), 338–375.
- Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 84(2), 191–215.
- Banks, G. C., Gooty, J., Ross, R. L., Williams, C. E., & Harrington, N. T. (2018). Construct redundancy in leader behaviors: A review and agenda for the future. *The Leadership Quarterly*, 29(1), 236–251.
- Beckmann, J., & Heckhausen, H. (2018). Motivation as a function of expectancy and incentive. In *Motivation and action* (pp. 163–220). Springer.
- Bem, D. J. (1972). Self-perception theory. *Advances in Experimental Social Psychology*, 6, 1–62.
- Berridge, K. C. (2009). Wanting and liking: Observations from the neuroscience and psychology laboratory. *Inquiry*, 52(4), 378–398.
- Biernat, M. (2003). Toward a broader view of social stereotyping. *American Psychologist*, 58(12), 1019–1027.
- Bing, M. N., Whanger, J. C., Davison, H. K., & VanHook, J. B. (2004). Incremental validity of the frame-of-reference effect in personality scale scores: A replication and extension. *Journal of Applied Psychology*, 89(1), 150.
- Block, J. (1961). *The Q-sort method in personality assessment and psychiatric research*. Charles C Thomas.
- Bollen, K. A. (1989). *Structural equations with latent variables*. Wiley.
- Bowles, S., & Gintis, H. (2011). *A cooperative species: Human reciprocity and its evolution*. Princeton University Press.
- Brunswik, E. (1952). *The conceptual framework of psychology*. (Int. Encycl. Unified Sci., v. 1, no. 10.). Univiversity of Chicago Press.
- Brunswik, E. (1955). Representative design and probabilistic theory in a functional psychology. *Psychological Review*, 62(3), 193–217.

- Burnes, B., & Cooke, B. (2013). Kurt Lewin's Field Theory: A Review and Re-evaluation. *International Journal of Management Reviews*, 15(4), 408–425.
- Buss, D. M. (1996). Social adaptation and five major factors of personality. In J. S. Wiggins (Ed.), *The five-factor model of personality: Theoretical perspectives*. (pp. 180–207). Guilford.
- Buss, D. M., & Craik, K. H. (1983). The act frequency approach to personality. *Psychological Review*, 90(2), 105–126.
- Carver, C. S., & Scheier, M. F. (1998). *On the self-regulation of behavior*. Cambridge.
- Cattell, R. B. (1945). The description of personality: Principles and findings in a factor analysis. *American Journal of Psychology*, 58(1), 69–90.
- Cheng, P. W. (1993). Separating causal laws from casual facts: Pressing the limits of statistical relevance. In D. L. Medin (Ed.), *The psychology of learning and motivation*. (Vol. 30, pp. 215–264). Academic Press.
- Chernyshenko, O. S., Stark, S., Drasgow, F., & Roberts, B. W. (2007). Constructing personality scales under the assumptions of an ideal point response process: Toward Increasing the flexibility of personality measures. *Psychological Assessment*, 19(1), 88–106.
- Ching, C. M., Church, A. T., Katigbak, M. S., Locke, K. D., Vargas-Flores, J. de J., Ibáñez-Reyes, J., Morio, H., Wenmei, S., Mastor, K. A., & Roslan, N. A. (2013). Cross-cultural generalizability of the Personality and Role Identity Structural Model (PRISM): Implications for trait and cultural psychology. *Journal of Research in Personality*, 47(6), 894–907.
- Christie, R., & Geis, F. L. (1970). *Studies in machiavellianism*. Academic Press.
- Cialdini, R. B., & Trost, M. R. (1998). Social influence: Social norms, conformity and compliance. In D. T. Gilbert, S. T. Fiske, & G. Lindzey (Eds.), *The handbook of social psychology, Vols. 1 and 2 (4th ed.)*. (pp. 151–192). McGraw-Hill.
- Clark, A. (2015). *Surfing uncertainty: Prediction, action, and the embodied mind*. Oxford.
- Cohen, J. (1992). A power primer. *Psychological Bulletin*, 112(1), 155–159.
- Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2003). *Applied multiple regression/correlation analysis for the behavioral sciences (3rd ed.)*. Erlbaum.
- Collins, J. (2001). *Good to great: Why some companies make the leap... And others don't*. Random House.
- Condon, D. M., Wood, D., & Möttus, R. (in press). Bottom up construction of a personality taxonomy. *European Journal of Psychological Assessment*.
- Cottrell, C. A., Neuberg, S. L., & Li, N. P. (2007). What do people desire in others? A sociofunctional perspective on the importance of different valued characteristics. *Journal of Personality and Social Psychology*, 92(2), 208–231.
- Cramer, A. O. J., Van der Sluis, S., Noordhof, A., Wichers, M., Geschwind, N., Aggen, S. H., Kendler, K. S., & Borsboom, D. (2012). Dimensions of normal personality as networks in search of equilibrium: You can't like parties if you don't like people. *European Journal of Personality*, 26(4), 414–431.
- Delton, A. W., & Robertson, T. E. (2016). How the mind makes welfare tradeoffs: Evolution, computation, and emotion. *Current Opinion in Psychology*, 7, 12–16.

- Denissen, J. J. A., Aken, M. A., Penke, L., & Wood, D. (2013). Self-regulation underlies temperament and personality: An integrative developmental framework. *Child Development Perspectives*, 7(4), 255–260.
- Dennett, D. C. (1996). *Darwin's dangerous idea: Evolution and the meanings of life*. Simon & Schuster.
- DeYoung, C. G. (2015). Cybernetic Big Five theory. *Journal of Research in Personality*, 56, 33–58.
- Diener, E., Ng, W., & Tov, W. (2008). Balance in life and declining marginal utility of diverse resources. *Applied Research in Quality of Life*, 3(4), 277–291.
- Douglas, J. E., & Olshaker, M. (1999). *The anatomy of motive*. Simon and Schuster.
- Einstein, A. (1934). On the method of theoretical physics. *Philosophy of Science*, 1(2), 163–169.
- Endsley, M. R. (1995). Toward a theory of situation awareness in dynamic systems. *Human Factors*, 37(1), 32–64.
- Ericsson, K. A., & Pool, R. (2016). *Peak: Secrets from the new science of expertise*. Houghton Mifflin Harcourt.
- Ericsson, K. A., & Simon, H. A. (1984). *Protocol analysis: Verbal reports as data*. the MIT Press.
- Feather, N. T. (1982). *Expectations and actions: Expectancy-value models in psychology*. Erlbaum.
- Flanagan, J. C. (1954). The critical incident technique. *Psychological Bulletin*, 51(4), 327.
- Fleeson, W., & Gallagher, P. (2009). The implications of Big Five standing for the distribution of trait manifestation in behavior: Fifteen experience-sampling studies and a meta-analysis. *Journal of Personality and Social Psychology*, 97(6), 1097–1114.
- Flegr, J. (2013). How and why Toxoplasma makes us crazy. *Trends in Parasitology*, 29(4), 156–163.
- Fox, M. C., Ericsson, K. A., & Best, R. (2011). Do procedures for verbal reporting of thinking have to be reactive? A meta-analysis and recommendations for best reporting methods. *Psychological Bulletin*, 137(2), 316–344.
- Fraley, R. C., Waller, N. G., & Brennan, K. A. (2000). An item response theory analysis of self-report measures of adult attachment. *Journal of Personality and Social Psychology*, 78(2), 350.
- Friston, K. J., Stephan, K. E., Montague, R., & Dolan, R. J. (2014). Computational psychiatry: The brain as a phantastic organ. *The Lancet Psychiatry*, 1(2), 148–158.
- Funder, D. C. (1991). Global traits: A Neo-Allportian approach to personality. *Psychological Science*, 2(1), 31–39.
- Funder, D. C. (1995). On the accuracy of personality judgment: A realistic approach. *Psychological Review*, 102(4), 652–670.
- Gershman, S. J., Horvitz, E. J., & Tenenbaum, J. B. (2015). Computational rationality: A converging paradigm for intelligence in brains, minds, and machines. *Science*, 349(6245), 273–278.
- Gintis, H. (2009). *The bounds of reason: Game theory and the unification of the behavioral sciences*. Princeton University Press.
- Goldberg, L. R., Johnson, J. A., Eber, H. W., Hogan, R., Ashton, M. C., Cloninger, C. R., & Gough, H. G. (2006). The International Personality Item Pool and the future of public-domain personality measures. *Journal of Research in Personality*, 40(1), 84–96.

- Gollwitzer, P. M. (1990). Action phases and mind-sets. In E. T. Higgins & R. M. Sorrentino (Eds.), *Handbook of motivation and cognition: Foundations of social behavior*, Vol. 2. (pp. 53–92). Guilford.
- Graziano, W. G., Habashi, M. M., Evangelou, D., & Ngambeki, I. (2012). Orientations and motivations: Are you a “people person,” a “thing person,” or both? *Motivation and Emotion*, 36(4), 465–477. <https://doi.org/10.1007/s11031-011-9273-2>
- Hammond, J. S., Keeney, R. L., & Raiffa, H. (2002). *Smart choices: A practical guide to making better decisions*. Crowne Business.
- Harms, P. D., Wood, D., & Spain, S. M. (2016). Separating the why from the what: Reply to Jonas and Markon (2015). *Psychological Review*, 123, 84–89.
- Hastie, R., & Dawes, R. M. (2010). *Rational choice in an uncertain world: The psychology of judgment and decision making*. Sage.
- Heckhausen, H. (1977). Achievement motivation and its constructs: A cognitive model. *Motivation and Emotion*, 1(4), 283–329.
- Heggestad, E., Morrison, M., Reeve, C., & McCloy, R. (2006). Forced-Choice Assessments of Personality for Selection: Evaluating Issues of Normative Assessment and Faking Resistance. *Journal of Applied Psychology*, 91(1), 9–24.
- Hennecke, M., Bleidorn, W., Hutteman, R., Wood, D., Luhmann, M., & Denissen, J. J. A. (2014). A three-part framework for self-regulated personality development across adulthood. *European Journal of Personality*, 28, 289–299.
- Hofstadter, D. R. (2007). *I am a strange loop*. Basic books.
- Holt, C. A., & Smith, A. M. (2009). An update on Bayesian updating. *Journal of Economic Behavior & Organization*, 69(2), 125–134.
- Jackendoff, R. (2009). Parallels and nonparallels between language and music. *Music Perception: An Interdisciplinary Journal*, 26(3), 195–204.
- Jones, D. N., & Figueredo, A. J. (2013). The core of darkness: Uncovering the heart of the Dark Triad. *European Journal of Personality*, 27(6), 521–531.
- Kelley, H. H. (1997). The “stimulus field” for interpersonal phenomena: The source of language and thought about interpersonal events. *Personality and Social Psychology Review*, 1(2), 140–169.
- Kelly, G. A. (1963). *A theory of personality: The psychology of personal constructs*. (1964-02630-000). W. W. Norton.
- Keltner, D., Gruenfeld, D., Galinsky, A., & Kraus, M. W. (2010). Paradoxes of power: Dynamics of the acquisition, experience, and social regulation of social power. In A. Guinote & T. K. Vescio (Eds.), *The social psychology of power*. (pp. 177–208). Guilford.
- Kenny, D. A. (1979). *Correlation and causality*. Wiley.
- Kihlstrom, J. F. (2013). The person-situation interaction. In D. E. Carlston (Ed.), *The Oxford handbook of social cognition* (pp. 786–805). Oxford.
- Krantz, D. H., & Kunreuther, H. C. (2007). Goals and plans in decision making. *Judgment and Decision Making*, 2(3), 137–168.

- Kruger, J., & Dunning, D. (1999). Unskilled and unaware of it: How difficulties in recognizing one's own incompetence lead to inflated self-assessments. *Journal of Personality and Social Psychology*, 77(6), 1121–1134.
- Kurzban, R. (2010). *Why everyone (else) is a hypocrite: Evolution and the modular mind*.
- Layard, R., Mayraz, G., & Nickell, S. (2008). The marginal utility of income. *Journal of Public Economics*, 92(8–9), 1846–1857.
- Le, H., Schmidt, F. L., Harter, J. K., & Lauver, K. J. (2010). The problem of empirical redundancy of constructs in organizational research: An empirical investigation. *Organizational Behavior and Human Decision Processes*, 112(2), 112–125.
- Lewin, K. (1943). Defining the “field at a given time.” *Psychological Review*, 50(3), 292–310.
- Lewin, K. (1946). Behavior and development as a function of the total situation. In L. Carmichael (Ed.), *Manual of child psychology*. (pp. 791–844). Wiley.
- Little, B. R. (2008). Personal projects and free traits: Personality and motivation reconsidered. *Social and Personality Psychology Compass*, 2(3), 1235–1254.
- Lowman, G. H., Wood, D., & Harms, P. D. (2020). *Assertiveness and power in the workplace: A functional field approach*.
- Lukaszewski, A. W., & Roney, J. R. (2011). The origins of extraversion: Joint effects of facultative calibration and genetic polymorphism. *Personality and Social Psychology Bulletin*, 37(3), 409–421.
- Manski, C. F. (2000). Economic analysis of social interactions. *The Journal of Economic Perspectives*, 14(3), 115–136.
- Markon, K. E., Krueger, R. F., & Watson, D. (2005). Delineating the structure of normal and abnormal personality: An integrative hierarchical approach. *Journal of Personality and Social Psychology*, 88(1), 139–157.
- McCrae, R. R. (2014). A more nuanced view of reliability specificity in the trait hierarchy. *Personality and Social Psychology Review*, 1–16.
- McCrae, R. R., & Costa, P. T. Jr. (2008). The five-factor theory of personality. In O. P. John, R. W. Robins, & L. A. Pervin (Eds.), *Handbook of personality: Theory and research (3rd ed.)*. (pp. 159–181). Guilford.
- McCrae, R. R., & Sutin, A. R. (2018). A Five-Factor Theory perspective on causal analysis. *European Journal of Personality*, 151–166. <https://doi.org/10.1002/per.2134>
- Miller, J. D., Lyman, D. R., Widiger, T. A., & Leukefeld, C. (2001). Personality disorders as extreme variants of common personality dimensions: Can the five factor model adequately represent psychopathy? *Journal of Personality*, 69(2), 253–276.
- Mischel, W., & Shoda, Y. (1995). A cognitive-affective system theory of personality: Reconceptualizing situations, dispositions, dynamics, and invariance in personality structure. *Psychological Review*, 102(2), 246–268.
- Möttus, R. (2016). Towards more rigorous personality trait-outcome research. *European Journal of Personality*, 30, 292–303.

- Nagengast, B., Marsh, H. W., Scalas, L. F., Xu, M. K., Hau, K.-T., & Trautwein, U. (2011). Who took the “x” out of expectancy-value theory? A psychological mystery, a substantive-methodological synergy, and a cross-national generalization. *Psychological Science*, 22(8), 1058–1066.
- Nesse, R. M. (2019). *Good reasons for bad feelings: Insights from the frontier of evolutionary psychiatry*. Penguin.
- Nicholls, J. G., Licht, B. G., & Pearl, R. A. (1982). Some dangers of using personality questionnaires to study personality. *Psychological Bulletin*, 92(3), 572–580.
- Nisbett, R. E., & Wilson, T. D. (1977). Telling more than we can know: Verbal reports on mental processes. *Psychological Review*, 84(3), 231–259.
- Novick, L. R., & Cheng, P. W. (2004). Assessing interactive causal influence. *Psychological Review*, 111(2), 455–485.
- O*NET. (2019). *O*NET OnLine*. <https://www.onetonline.org/>
- Paulhus, D. L. (2014). Toward a taxonomy of dark personalities. *Current Directions in Psychological Science*, 23(6), 421–426. <https://doi.org/10.1177/0963721414547737>
- Paulhus, D. L., Neumann, C. S., & Hare, R. D. (2009). *Manual for the self-report psychopathy scale*.
- Paulhus, D. L., & Williams, K. M. (2002). The dark triad of personality: Narcissism, Machiavellianism, and psychopathy. *Journal of Research in Personality*, 36(6), 556–563.
- Pearl, J. (2009). *Causality: Models, reasoning, and inference*. (Vol. 2). Cambridge University Press.
- Pearl, J., & Mackenzie, D. (2018). *The book of why: The new science of cause and effect*. Basic.
- Pytlik Zillig, L. M., Hemenover, S. H., & Dienstbier, R. A. (2002). What do we assess when we assess a Big 5 trait? A content analysis of the affective, behavioral and cognitive processes represented in the Big 5 personality inventories. *Personality and Social Psychology Bulletin*, 28(6), 847–858. <https://doi.org/10.1177/0146167202289013>
- Rainio, K. (2009). Kurt Lewin’s dynamical psychology Revisited and revised. *Dynamical Psychology: An International, Interdisciplinary Journal of Complex Mental Processes*.
- Raskin, R., & Terry, H. (1988). A principal-components analysis of the Narcissistic Personality Inventory and further evidence of its construct validity. *Journal of Personality and Social Psychology*, 54(5), 890–902. <https://doi.org/10.1037/0022-3514.54.5.890>
- Rauthmann, J. F., Sherman, R. A., & Funder, D. C. (2015). Principles of situation research: Towards a better understanding of psychological situations. *European Journal of Personality*, 29(3), 363–381.
- Reis, H. T. (2008). Reinvigorating the concept of situation in social psychology. *Personality and Social Psychology Review*, 12(4), 311–329.
- Schelling, T. C. (1960). *The strategy of conflict*. Harvard University Press.
- Seuss, Dr. (2015). *How the Grinch Stole Christmas! Book and Grinch*. Random House.
- Simon, H. A. (1997). *The sciences of the artificial*. MIT press.
- Skinner, B. F. (1981). Selection by consequences. *Science*, 213(4507), 501–504.
- Soltes, E. (2016). *Why they do it: Inside the mind of the white-collar criminal*. PublicAffairs.

- Su, R., Rounds, J., & Armstrong, P. I. (2009). Men and things, women and people: A meta-analysis of sex differences in interests. *Psychological Bulletin*, 135(6), 859–884.
- Thorndike, E. L. (1913). *The psychology of learning* (Vol. 2). Mason-Henry.
- Tolman, E. C. (1938). The determiners of behavior at a choice point. *Psychological Review*, 45(1), 1–41.
- Trivers, R. (2011). *The folly of fools: The logic of deceit and self-deception in human life*. Basic.
- Vroom, V. H. (1964). *Work and motivation*. Wiley.
- Wiggins, J. S. (1997). In defense of traits. In R. Hogan, J. A. Johnson, & S. R. Briggs (Eds.), *Handbook of personality psychology*. (pp. 95–141). Academic Press.
- Wilson, T. D. (2004). *Strangers to ourselves*. Harvard University Press.
- Wilson, T. D., & Gilbert, D. T. (2005). Affective forecasting: Knowing what to want. *Current Directions in Psychological Science*, 14(3), 131–134.
- Wilt, J., & Revelle, W. (2015). Affect, behaviour, cognition and desire in the Big Five: An analysis of item content and structure. *European Journal of Personality*, 29(4), 478–497.
- Wood, D. (2015). Testing the lexical hypothesis: Are socially important traits more densely reflected in the English lexicon? *Journal of Personality and Social Psychology*, 108(2), 317–335.
- Wood, D., Gardner, M. H., & Harms, P. D. (2015). How functionalist and process approaches to behavior can explain trait covariation. *Psychological Review*, 122(1), 84–111.
- Wood, D., & Harms, P. (2017). Evidence of non-corresponsive causal relationships between personality traits and social power over time. *Personality and Social Psychology Bulletin*, 43(1), 33–45.
- Wood, D., Harms, P., Lowman, G. H., & DeSimone, J. A. (2017). Response speed and response consistency as mutually validating indicators of data quality in online samples. *Social Psychological and Personality Science*, 8, 454–464.
- Wood, D., Lowman, G., Harms, P. D., & Spain, S. M. (2017). Using functional fields to formally represent the meaning and logic of actions: A worked example using ‘dark’ actions. *Personality and Individual Differences*, 136, 24–37.
- Wood, D., & Roberts, B. W. (2006). Cross-sectional and longitudinal tests of the Personality and Role Identity Structural Model (PRISM). *Journal of Personality*, 74(3), 779–809.
- Wood, D., Spain, S. M., & Harms, P. D. (in press). Functional approaches to representing the interplay of situations, traits, and behavior. In D. C. Funder, R. A. Sherman, & J. F. Rauthmann (Eds.), *Handbook of Psychological Situations*. Oxford.
- Wood, D., Spain, S. M., Monroe, B. M., & Harms, P. D. (in press). Using functional fields to represent accounts of the psychological processes that produce actions. In J. F. Rauthmann (Ed.), *Handbook of Personality Dynamics and Processes*. Academic Press.
- Wood, D., Tov, W., & Costello, C. (2015). What a _____ thing to do! Formally characterizing actions by their expected effects. *Journal of Personality and Social Psychology*, 108, 953–976.
- Wright, S. (1934). The method of path coefficients. *The Annals of Mathematical Statistics*, 5(3), 161–215.

Yang, Y., Read, S., Denson, T. F., Xu, Y., Zhang, J., & Pedersen, W. C. (2014). The key ingredients of personality traits: Situations, behaviors, and explanations. *Personality and Social Psychology Bulletin*, 40, 79–91.

Footnotes

¹ In a field model of the *actual* causal structure of the world, which may be notating as F_t – there may be no ‘rock-bottom’ to the level at which some modeled direct effect $[X \rightarrow Y]$ can no longer be further mediated. But in models of some person’s *perception* of the causal structure of the world, $F_{p(t)}$, we could reach such a rock-bottom, where further elaboration would be inappropriate. This might be where a person says “I believe X leads to Y, but I really can’t say why or how – I guess I’ve never thought about it.” These might be places where a person’s mental model *could* be elaborated in the future, but where it has reached its limit of complexity at this particular time.

² These ideas are comparable to Pearl’s (2009) description of how specifying a causal model M and a particular realization of the background variables u combine to create a particular causal world w ; see his Definition 7.1.8. More specifically, an equation f_{XYp} which determines the force that X will exert on Y in model p , can be regarded as a sub-equation of the more general equation f_{Yp} that determines how the level of situational states s_t more generally determine the level of Y. In essence, the role of factor X within the broader equation f_{Yp} is moved outside of the equation. For instance, if $f_{Yp} = \frac{m_1 m_2 G}{r^2}$ – i.e., within model p , the only force determining the level of Y is *Newtonian gravity* – then we can move m_1 outside of the equation to estimate the sub-equation $f_{m_1 Y} = \frac{m_2 G}{r^2}$ or $[m_1 \xrightarrow{m_2 G/r^2} Y]$.

This is analogous to the understanding in multiple regression models that when we observe interactive effects of X and Z on Y, $f_Y = XZ$ or $[XZ \rightarrow Y]$, we can re-represent this as meaning that the effect of X on Y is conditioned by Z, i.e., $f_{XY} = Z$ or $[X \xrightarrow{Z} Y]$ (Cohen et al., 2003).

³ Some might prefer a factor’s *traits* to be defined as its *stable* properties over time, or the field effects that the factor brings to *any* situation. This can be accommodated by specifying that t within $F_{p(j,t)}$ is *all situations at all times*. That is: $F_{p(j,t)}$ describes how person p is expected to modify their understanding of any situation in which j is present – no matter how unusual or distant in the future. For instance, the traits of Abigail and Beatrice in Table 1 (specifically: their preference functions) are essentially represented in such a manner.

⁴ This may correspond most directly to Pearl’s *probability of necessity and sufficiency* (PNS; Pearl, 2009, pp. 291, Eq. 9.21), although whereas Pearl’s equation is discussed in reference to estimating differences in the *probabilities of particular states* – e.g., $E(s_{t,s_j=1})$ versus $E(s_{t,s_j=0})$ – this method could be used to estimate differences in *force levels* which may be continuous.

⁵ Modifications to Equations 3a-b could make the range of verbal statements that can be well-represented as test functions even broader. For instance, verbal statements might be best represented as *ratios* of two forces. For instance, JDM and cognitive researchers sometimes conceptualize traits such as *callousness* versus *kindness* as *welfare-tradeoff ratios* (WTRs; Delton & Robertson, 2016; Lukaszewski & Roney, 2011) which can be defined as the ratio the valuation of others’ well-being over one’s own, or $\left[\frac{WellBeing_{Others} \Rightarrow U_p}{WellBeing_p \Rightarrow U_p} \right]$. Similarly, many concepts related to *efficiency* might be best formalized as ratios, such as the company’s estimate of the *cost-per-unit* to create a product by process i $\left(\left[\frac{i \Rightarrow Money_{Co}}{i \Rightarrow UnitsMade_{Co}} \right] \right)$; Collins, 2001), or a vehicle’s *miles-per-gallon* $\left(\left[\frac{Drove(Car)_p \Rightarrow MilesTravelled_p}{Drove(Car)_p \Rightarrow GallonsUsed_p} \right] \right)$.

⁶ For instance, in examining differences in how endorsement of these terms correlated with endorsement of other IPIP terms, there were some indications that calling oneself *kind* had a more behavioral flavor, indicating that the person (p) is more likely to do things that improve others’ well-being, perhaps roughly $[WellBeing_{Others} \Rightarrow U_p]$, whereas *caring* had a more internal flavor, indicating that the person’s feelings are impacted by noticing effects to other’s well-being, perhaps roughly $[WellBeing_{Others} \Rightarrow Satisfied_p]$.

As elaborated shortly, such refinements would suggest that the statement “she is *kind* because she is *caring*” may be a more appropriate statement than “she is *caring* because she is *kind*” for describing how *kindness* and *caringness* affect one another, because the test function for being *caring* can be represented as part of a mediating pathway within the test function for being *kind*: $[WellBeing_{others} \Rightarrow Satisfied_p \Rightarrow U_p]$.

Table 1. Functional field detailing expected experiences of Abigail and Beatrice in Engineering versus Professor job environments to produce fields models represented in Figure 1.

Equation within the functional field $\mathbf{F}_p$	Force within field at a given time $\mathbf{F}_{p(t)}$
$Job(Engineer)_p * .2 + Job(Professor)_p * .9 \rightarrow$	$[At(Job)_p \rightarrow With(People)_p]$
$Job(Engineer)_p * .7 + Job(Professor)_p * .5 \rightarrow$	$[At(Job)_p \rightarrow Money_p]$
$Job(Engineer)_p * .8 + Job(Professor)_p * .1 \rightarrow$	$[At(Job)_p \rightarrow With(Things)_p]$
$Is(Abigail)_p * .1 + Is(Beatrice)_p * .7 \rightarrow$	$[With(People)_p \rightarrow U_p]$
$Is(Abigail)_p * .5 + Is(Beatrice)_p * .3 \rightarrow$	$[Money_p \rightarrow U_p]$
$Is(Abigail)_p * .4 + Is(Beatrice)_p * 0 \rightarrow$	$[With(Things)_p \rightarrow U_p]$

Note. The *jobs* and *identities* that person p can take are mutually exclusive: if the person's job is an *Engineer*, then it is not a *Professor*; if the person is *Abigail*, the person is not *Beatrice*.

Table 2. Example of an *Elaborated Situational Judgment Test (ESJT)* Scenario with Participant Responses.

<u>Situation (t)</u>			
You are currently working on a number of different projects that require all of your time and attention. Your coworker comes to you and asks you to take on several of her tasks as she is too busy.			
<u>Possible Actions (i)</u>			
		<i>Tell her you'd be happy to help out.</i>	<i>Refuse to take on extra work at this time.</i>
#	Features / Factors / Dimensions (j)	Expected effect ratings ($s_{j_{p(t,i)}}$)	
1	Expressed disapproval with your coworker's behavior <i>ExpDisapproval(Co)_p</i>	0	+2
2	Your coworker's level of job security at the company <i>JobSecurity_{Co}</i>	1	-1
3	Quality of interaction with coworker <i>IntQuality(Co)_p</i>	0	+1
4	Have a good working relationship with your coworker <i>RelQuality(Co)_p</i>	+1	-1
5	You completing your job responsibilities effectively <i>DidJob_p</i>	-1	1
6	Your company's level of success <i>Success_{company}</i>	-1	1
7	Acted appropriately within your role in the company <i>ActedAppropriately_p</i>	0	+1
8	Your level of job security at your company <i>JobSecurity_p</i>	0	+1
9	Action likelihood <i>U_p</i>	+1	-1

Note. Scenario adapted from scenario rated by participants in Lowman et al. (2020). The element *p* indicates the person interpreting and responding to the test. Feature numbers correspond to those shown in Figures 2a-c.

Table 3. Examples of How Particular Test Functions Can Be Translated into Particular Verbal Statements.

#	Test Function	Compatible Verbal Statement
Abstracted test function		
0	$[X \xrightarrow{\in[LB,UB]} Y]_{p(s_p)}$	P: "In situation s_p , the total effect of X on Y is between LB and UB "
Original test function:		
1	$[Watching(Sports)_p \xrightarrow{\in[1,1]} Satisfied_p]_p$	P: "I like watching sports." / "I enjoy watching sports" / "I find watching sports satisfying."
(A) Variations in <u>bounds</u> [LB,UB] of the original test function:		
2	$[Watching(Sports)_p \xrightarrow{\in[.5,1]} Satisfied_p]_p$	P: "I <i>love</i> watching sports!"
3	$[Watching(Sports)_p \xrightarrow{\in[-1,1]} Satisfied_p]_p$	P: "I'm <i>pretty indifferent</i> to watching sports."
4	$[Watching(Sports)_p \xrightarrow{\in[1,1]} Satisfied_p]_p$	P: "I <i>don't</i> like watching sports."
5	$[Watching(Sports)_p \xrightarrow{\in[-1,-1]} Satisfied_p]_p$	P: I <i>dislike</i> watching sports."
7	$[Watching(Sports)_p \xrightarrow{\in[-1,-.5]} Satisfied_p]_p$	P: "I <i>hate</i> watching sports!"
8	$[Watching(Sports)_p \xrightarrow{\in[-1,<fTom]} Satisfied_p]_p$	P: "I like watching sports <i>less than Tom does</i> ."
9	$[Watching(Sports)_p \xrightarrow{\in[>f_p,1]} Satisfied_p]_p$	P: "I like watching sports <i>more than the average person</i> ."
10	$[Watching(Sports)_p \xrightarrow{\in[>f_p,<fTom]} Satisfied_p]_p$	P: I enjoy watching sports <i>more than the average person but less than Tom</i> "
11	$[Watching(Sports)_p \xrightarrow{\in[>fPlaying(Sports),Sat^1]} Satisfied_p]_p$	P: I enjoy watching sports <i>more than I enjoy playing sports</i> "
(B) Variations in <u>test conditions</u> (t) of the original test function:		
11	$[Watching(Sports)_p \xrightarrow{\in[1,1]} Satisfied_p]_{p(With(Tom)_p)}$	P: "I like watching sports <i>with Tom</i> ."
12	$[Watching(Sports)_p \xrightarrow{\in[1,1]} Satisfied_p]_{p(\neg With(Tom)_p)}$	P: "I like watching sports <i>when I'm not with Tom</i> ."
13	$[Watching(Sports)_p \xrightarrow{\in[1,1]} Satisfied_p]_{p(With(Tom)_p \neg \neg With(Tom)_p)}$	P: "I like watching sports <i>more when I'm with Tom</i> ."
(C) Variations in <u>features</u> (X and Y) of the original test function:		
14	$[Watching(Sports)_{Tom} \xrightarrow{\in[1,1]} Satisfied_{Tom}]_p$	P: "Tom likes watching sports."
15	$[Watching(Sports)_p \xrightarrow{\in[1,1]} Satisfied_p]_p$	P: "The average person likes watching sports."
16	$[Watching(Sports)_p \xrightarrow{\in[1,1]} Satisfied_{Tom}]_p$	P: "Tom likes it when I watch sports"
17	$[Watching(Baseball)_p \xrightarrow{\in[1,1]} Satisfied_p]_p$	P: "I like watching <i>baseball</i> ."
18	$[Playing(Sports)_p \xrightarrow{\in[1,1]} Satisfied_p]_p$	P: "I like <i>playing</i> sports."
19	$[Eating(IceCream)_p \xrightarrow{\in[1,1]} Satisfied_p]_p$	P: "I like <i>eating ice cream</i> ."
20	$[Watching(Sports)_p \xrightarrow{\in[1,1]} RelatedTo(Tom)_p]_p$	P: "Watching sports <i>improves my relationship with Tom</i> "
21	$[Watching(Sports)_p \xrightarrow{\in[1,1]} IU_p]_p$	P: "I find watch sports <i>useful</i> "
22	$[Watching(Sports)_p \xrightarrow{\in[1,1]} U_p]_p$	P: "I <i>am motivated</i> to watch sports"

Note. For all statements, the features that has been altered from the original test function in row #1 are shown in bold. IU = instrumental utility (roughly: usefulness); U = ultimate appraisal.

Table 4. Some Provisional Generic Test Functions for Representing Common Types of Verbal Statements.

Generic Verbal Statement	Provisional Generic Test Function
"P [is motivated by/wants/is inclined to] X "	$\left[X \xrightarrow{\in[.1,1]} U_p \right]$
"P finds it useful to X "; "P finds X useful"	$\left[X \xrightarrow{\in[.1,1]} IU_p \right]$
"P [likes/enjoys] X "; "P finds X [pleasant/satisfying]"	$\left[X \xrightarrow{\in[.1,1]} Satisfied_p \right]$
"P [can/is able to] X "	$\left[TriedTo(X)_p \xrightarrow{\in[.1,1]} s_j \right]$
"P tries to X "	$\left[X \xrightarrow{\in[.1,1]} MetGoal_p \right]$
"P tends to do i when X " [response norm]	$\left[X \xrightarrow{\in[.1,1]} i_p \right]$

Note. In all of the verbal forms, we can replace X with any object in both the generic test function and verbal statement to arrive at a sensible formal representation of the statement. IU = instrumental utility (roughly: usefulness); U = ultimate appraisal.

Figure 1. Field models of combining particular *persons* (*Abigail* and *Beatrice*, or persons *A* and *B*) and *jobs* to construct potential situations, or $F_p(\text{job})$. The specific scenario being imagined is indicated at the bottom right corner of each field model. Nodes shaded blue indicate large positive expected effects, and unshaded cells indicate no expected effects positively or negatively. For each combination of a person and a job, the person's total expected appraisal of being at the job is indicated by the level of U_p indicated in the model.

(2a) Coworker = Your Manager

(2b) Coworker = Your Subordinate

(2c) Difference:

Figure 2. Empirically-identified field structures of participant expectations of expressing disapproval with a coworker's actions when the coworker is your manager (Figure 2a) versus your subordinate (Figure 2b) within the Lowman, Wood, & Harms (LWH) study. Nodes shaded blue indicate expected positive effects, nodes shaded red indicate expected negative effects, with darker coloration indicating strong effects. Solid and dotted lines indicate positive and negative forces, respectively. The differences between the estimated forces across models is given in Figure 2c.

Figure 3. Illustration of how a range of common abstract action and person descriptors can be represented as corresponding to the level of particular forces within a functional field model. For instance, calling a person *caring* can be interpreted as communicating that the level of path $[WellBeing_{Others} \Rightarrow U_p]$ (roughly: the total force that the expected well-being of others' well-being will exert on the person's ultimate appraisal of the action) is above some threshold.

Figure 4a. Field representation of beliefs related to the statement: “p is *unsociable* because p is *shy*.”

Example:

She is *unsociable*, $[With(pp)_p \Rightarrow U_p] \in [-1, -1]$ because she highly values her safety $[Safe_p \rightarrow U_p] \in [.4, 1]$, and is *shy* (believes being near people is unsafe) $[With(pp)_p \rightarrow Safe_p] \in [-1, -1]$.

General representation

Example

Figure 4b. Field representation of beliefs around Cramer et al.'s (2012) statement: “one is unlikely to enjoy parties if one does not like people” (p. 416).

Negative example: This person *dislikes people* $[With(pp)_p \rightarrow Satisfied_p] \in [-1, -1]$. But despite the fact that parties *typically have people* $[At(Party)_p \rightarrow With(pp)_p] \in [.8, 1]$, for as-yet-unrepresented reason(s), this person *typically does* like parties $[At(Party) \Rightarrow Satisfied_p] \in [.1, 1]$.

Figure 4. Two illustrations of how traits can be represented as sources of other traits within field models. Solid lines and dotted lines indicate positive versus negative paths, respectively.

(5a) An SEM-type representation of *callousness* as a possible common cause of measured levels of ‘dark’ tendencies

(5b) Field representation of dark tendencies as a person’s total valuation of certain outcomes.

(5c) Field representation of *callousness* as a valuation serving as a common mediator of dark tendencies.

Figure 5. Illustration of how functional fields can represent propositions about relations between traits which are usually explored by structural equation modeling. For Figure 5b and 5c, solid versus dotted lines indicate paths which are expected to be positive and negative for the majority of people, respectively. And “...” indicates the field representations could be further elaborated to represent the ways a person could injure, deceive, or outrank other people.

Figure 6. Simple field model of how Big Five dimensions may approximate major *values* (or $[X \rightarrow U_p]_p$ expectancies). As noted in the text, the exception is *emotional stability* versus *neuroticism*, which is suggested as perhaps better represented as a person's understanding of the degree to which their safety is at risk across a broad range of possible actions $[i \rightarrow Safe_p]_p$.