Journal of Contextual Behavioral Science 18 (2020) 128–145

Contents lists available at ScienceDirect

Journal of Contextual Behavioral Science

journal homepage: www.elsevier.com/locate/jcbs

Discussion

Process-based functional analysis can help behavioral science step up to novel challenges: COVID - 19 as an example

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ARTICLE INFO

Keywords
Functional analysis
Diagnosis
Processes of change
Evolution
Process based therapy: process-based functional analysis

ABSTRACT

Historically speaking, the behavioral tradition advanced functional analysis as a method of applying existing principles to novel situations. In the more than half a century since that idea was advanced, functional analysis has either fallen into disuse, as in most of applied psychology, or has been used but modified to a point that is virtually inapplicable elsewhere, as in applied behavior analysis work with severe developmental disabilities. In this paper we argue that the current challenges with COVID-19 present an ideal time to reinvigorate functional analysis by combining it with the growing body of evidence on processes of change, organized under an extended evolutionary meta-model. This new form of *process-based functional analysis* takes advantage of the strengths of contextual behavioral science, while opening avenues of fruitful interaction with other wings of intervention and evolutionary science more generally. Using the psychological flexibility model as an example, we show how this approach solves the key problems of classical functional analysis and helps professionals deal with novel challenges such as those posed by COVID-19. Humanity is now facing an extraordinary and unexpected situation. Behavioral science needs to rise to that challenge in a way that provides both immediate practical value and greater assurance of long-term benefits for our understanding of human complexity more generally. Process-based functional analysis can be a vehicle to do just that.

COVID-19 (SARS-CoV-2) is presenting an extraordinary human challenge to the world community in almost every area of human life: medical, economic, educational, social, and recreational. Despite the extraordinary breadth of impact of the pandemic it is worth noticing that the behavioral sciences are barely visible in the public or policy discussions. Instead, behavior change advice is being doled out in a common-sense way. This can and does work in some cases, but without behavioral scientists' involvement, there is no fall back when public health information alone is not enough.

People are told to physically distance, or to wear masks, but not how to make those actions occur in ways that are sustainable and that are supported within the group, based on good evidence. People are told periodically to stop touching their face by public health officials, an intervention known to be weak, while easy, effective, and long-lasting empirically tested methods such as self-monitoring (Nelson, Boykin, & Hayes, 1982) are ignored because behavioral scientists are not part of the discussion. As resistance grows and public health advice become politically divisive and openly disregarded, the dangers of merely instructing behavior change become clearer. Psychologists could have warned of the dangers of this approach, based on the dynamics of human motivation (Ryan and Deci, 2006).

Looking ahead to the future, vaccines are held out as a future savior, but without coming to terms with the frequency of vaccine refusal in the case of safe and tested vaccines that are available for other diseases right now (e.g., Hough-Telford et al., 2016; Lee, Whetten, Omer, Pan, & Salmon, 2016). Behavioral scientists know that although there are small hopeful studies using such methods as motivational interviewing (Gagneur et al., 2018), there are currently no readily scalable methods of undermining vaccine hesitancy (Dubé, Gagnon, & MacDonald, 2015). Meanwhile policy makers are currently pouring billions of dollars of emergency funding into vaccine development but only a tiny fraction such resources into the solution of the behavioral aspects of vaccine use, which will render the existence of a vaccine far less than a cure regardless of how biologically potent the vaccine proves to be.

Almost all of the challenges presented by COVID-19 contain behavioral challenges. The content of public health guidance given is generally scientifically grounded when epidemiology is involved, but it appeals to common sense and lay opinion when behavioral and

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https://doi.org/10.1016/j.jcbs.2020.08.009
Received 8 June 2020; Received in revised form 18 August 2020; Accepted 20 August 2020
Available online 25 August 2020

psychological aspects are at issue. With few exceptions, behavioral scientists are not even at the table.

The one area in which behavioral science appears to be fairly visible is in the area of the mental health impact of COVID-19, but here the past half century of biomedicalizing human suffering is forcing the conversation into narrow and often unhelpful channels. Newspaper stories dutifully report how many people show "signs of anxiety or depression" in response to COVID-19 but anyone living through this crisis knows that 10 out of 10 people are facing at least some psychological challenges in adjusting to the new reality. A syndromal approach simply cannot orient society to the behavioral challenges of the virus considered broadly.

Even within that narrowed field of vision the weakness of the traditional syndromal approach is fully revealed by the raw realities of the COVID-19 crisis. If it is true, for example, that a larger percentage of the world's population is now beginning to develop a diagnosable syndrome in response to the extra-ordinary challenges the world community faces, who could treat all of these cases with evidence-based psychosocial methods? In the developed world only a small fraction of people seeking help for mental health problems receive such treatment now (Harvey & Gumport, 2015), and in lower- and middle-income countries virtually no one does (Patel et al., 2018).

In much the same way that the pandemic has cast a light on the grotesque and long-lasting health disparities surrounding issues of race, ethnicity, economic class, and geography, COVID-19 has helped explain why society does not look to mainstream psychosocial intervention science in times of crisis. In the public mind, psychological intervention is for those poor souls with "mental illness", not for people in general. As it becomes clearer that the pandemic might last many months or even years and might possibly transform the world to a new normal (possibly until a vaccine is developed), however, there is time to step forward with an alternative agenda and to mobilize behavioral science researchers around the planet around a coherent strategic vision that might make a difference.

The purpose of the present paper is to argue that the ongoing integration between behavioral science and evolutionary science (Hayes, Hofmann, & Wilson, 2020) provides a range of methodological and strategic steps that might help ameliorate this disconnection. In particular we wish to focus on how an extended evolutional meta-model (Hayes et al., 2019) can be combined with the decades of careful research on identifying processes of change in the form of intervention moderation and mediation, to create a new and more effective form of functional analysis that can be rapidly deployed in to step up to novel challenges.

1. The novel challenges of a novel virus

The challenges of a novel situation show why behavioral scientists who are interested in change hold theoretical principles, processes, and models to be of such importance. By definition, a novel situation is one in which it is the external validity of existing scientific knowledge that is at stake.

Virtually every wing of intervention science has long agreed that processes, principles, and models are key to developing the scientific flexibility to rise to unique challenges. Said in another way knowledge of successful techniques is likely to be of lower generality or scope than is knowledge of successful principles.

This is the core position of virtually every wing of applied psychology. In the founding document of applied behavior analysis Don Baer, Montrose Wolf, and Todd Risley (1968) argued that principles and not just techniques were important because they show how "procedures may be derived," allowing applied knowledge to "expand systematically" (p. 96). Aaron Beck (1976) extoled the value of a system of intervention rather that "a simple cluster of techniques" noting that "a well-developed system provides (a) a comprehensive theory or model of psychopathology and (b) a detailed description of and guide to therapeutic techniques related to this model … [with] a clear blueprint of the general principles and specific procedures." (p. 278). Gordon Paul (1969) said that a key feature of knowing how to help people, was not just knowing what intervention technique to try but if it works to know "how does it come about" (p. 44), referring to the change processes of the intervention technique.

Within the behavioral tradition writ large, psychological principles were to be applied to novel situations using functional analysis (Kanfer & Saslow, 1969). Classic functional analysis was more conceptual than empirical. It consisted of five steps (Haynes & O'Brien, 1990):

1. *Identify potentially relevant characteristics of the individual client, his or her behavior, and the context in which it occurs* via *broad assessment.*
2. *Organize that information into a preliminary analysis expressed in terms of behavioral principles so as to identify important causal relationships that might be changed.* Beginning with a broad funnel of information (Hawkins, 1979) the analyst was asked to gradually narrow the focus of assessment as forms of action, motivation, and context was considered.
3. *Gather additional information the preliminary analysis and finalize the conceptual functional analysis, after adding measurement data on the primary components and putting procedures in place for a continuing evaluation.*
4. *Devise an intervention based on the conceptual functional analysis.* Because behavioral principles at the time were contextually bound and pragmatic, the hope was that functional analysis would directly suggest intervention options.
5. *Implement treatment and assess change.*
6. *If the outcome is unacceptable, repeat this analytic cycle again, beginning with step 2 or 3 above.*

Stated in its most basic form, this model is little more than a delineation of the key steps in effective problem solving: gather initial information, interpret it, gather additional information if needed, come up with an idea, test it, and repeat the entire cycle if it doesn't work. The main difference is that classic functional analysis referred to principles of behavior contained within "operationally defined learning theory" (Franks & Wilson, 1974, p. 7) particularly from laboratory studies of non-human animals.

In the history of behavioral and cognitive behavioral intervention science, this approach yielded many early benefits as the principles of operant and classical conditioning, and social learning theory, were applied to human complexity. It did not last long. The third edition of the Diagnostic and Statistical Manual of the American Psychiatric Association (DSM; American Psychiatric Association, 1980) and its linkage to science funding and insurance reimbursement soon overwhelmed resistance from behavioral psychologists (e.g., Schact & Nathan, 1977) and the era of "protocols for syndromes" began in earnest (Hayes & Hofmann, 2017).

Functional analysis as a way to understand complex human behavior gradually became almost invisible, except in applied behavior analysis (Hayes & Follette, 1992). Even there, however, classic functional analysis as understood in early behavior therapy was largely thrown aside. Within behavior analysis the term "functional analysis" came to mean an empirical test of whether a specific behavior was maintained by attention, escape, sensory stimulation, or tangible consequences (Iwata, Wong, Riordan, Dorsey, & Lau, 1982). Functional analysis defined that way is today quite common in work with severe developmental disabilities (Beavers, Iwata, & Lerman, 2013), but is rarely used outside that domain. Its limited range can be explained by the fact that even the most rudimentary receptive language skills such a bi-directional naming renders it largely inapplicable (Belisle, Stanley, & Dixon, 2017). Classical functional analysis is moribund as applied to the complex actions of verbally capable human beings, but if the reason for its decline can be solved, it fully deserves to be brought back into the center of intervention science (Hofmann & Hayes, 2019).

We will argue that if the challenges presented by COVID-19 are

addressed by a more robust form of functional analysis, the field will be left not just with possible new methods for addressing the behavioral aspects of a pandemic, but with a more fundamental and functional understanding of human complexity. In making that argument we will begin by enumerating the key difficulties face by classic functional analysis, and then will review what has been said to be the fundamental features of contextual behavioral science (CBS) research strategy. We will then attempt to show how a new form of functional analysis is rising within process-based therapy that can solve the problems of classic functional analysis and can make good use of the strengths of contextual behavioral science research. If that is true, we believe that functional analysis can be repositioned at the core of functional contextual research on the psychological aspects of the COVID-19 crisis, and with long-term benefits for our understanding of human complexity more generally.

2. The key problems with classic functional analysis

The key problems with classic functional analysis were summarized decades ago by Hayes and Follette (1992). With some amplification and explication, their list still seems relevant today. The problems include:

1. *The key dimensions of initial assessment need to be specified a priori.* The behavioral tradition has failed this test. Behavioral principles specify how to think of given actions in context, but not which actions to focus on. Perversely, the DSM as a clinical taxonomy functioned as a set of psychological prototypes even while failing as an empirically validated set of co-varying features. Once the functional analyst began to look for features of a given person's syndrome, classic functional analysis had a target, but that approach had the effect of forcing functional and contextual thinking into a biomedical mold. From there the possible scientific and practical benefits of functional analysis were often lost. The role of functional analysis was reduced to generating overly general prescriptions for hypothetical syndromes and grouping these prescriptions into recommended treatment protocols. This "protocols for syndromes" approach has not succeeded in part because 1) progress on identifying underlying mental disease entities is absent, and 2) highly specific treatment effects have not emerged for nearly any syndrome (see Hayes and Hofmann, 2018a).
2. *The principles applied cannot be from an excessively limited set.* Direct contingency principles cannot alone account for the complex role of human cognition in human action. We now know that human cognition can fundamentally alter what functions as a consequence, how motivation works, how the antecedent environment impact on action (Hayes, Barnes-Holmes, & Roche, 2001). Cognition can divide a behavioral stream into subcategories of "emotion" or "self" and so on. In addition, there are levels of human functioning that go beyond the psychological level of analysis. People are in social relationships, and these are nested in larger cultural groups; the biophysiology of people (genes, epigenes, brain circuits, and so on) impacts their functioning, as does the ecosystem within, given that the human body encompasses more nonhuman cells than human ones. All of that is ignored in classical functional analysis.
3. *It needs to be specified how to move from functional analysis to intervention recommendations.* If there are multiple possible targets of intervention or maintaining conditions are not readily and obviously modifiable, classic functional analysis is largely mute. Procedures that orient clinicians to possible controlling variables, but not to a decision-making process that specifies which variables to focus on during a given phase of intervention, nor how to alter these variables and in which sequence, is neither disseminable nor likely to be effective in fostering clinical outcomes (Hayes & Follette, 1992).
4. *The adequacy of functional analysis itself needs to be continuously assessed at the idiographic and nomothetic level.* Principles of change apply to particular people, not averages, but our statistical and methodological approaches tend to be nomothetic in origin, and their usefulness in each instance is often unanalyzed. This disconnect between the practical goals of clinicians and the goals of many researchers has likely contributed to the slow uptake of empirically supported treatments by the practitioner community (Hayes et al., 2019).

If functional analysis is to be the vehicle for rising to the challenge of novelty, such as in the current COVID-19 crisis, all these problems need to be solved.

3. The strategic vision of contextual behavioral science

In the inaugural issue of the *Journal of Contextual Behavioral Science*, Hayes, Barnes-Holmes, & Wilson (2012) laid out a prescriptive agenda for CBS research. Because we are addressing how functional analysis should be a core feature of a response to the COVID-19 crisis by CBS researchers, it seems worth summarizing that agenda and providing orienting examples so that the fit between our approach to functional analysis and the CBS tradition can be readily assessed. Nine key recommendations were made, with several examples of possible research within each. Hayes, Barnes-Holmes, & Wilson (2012) called for behavioral science research with the following features.

1. *Greater connection with multi-dimensional and multi-level evolutionary science.* An example was research on the epigenetic effects of psychological processes, and how these in turn impact the genetic regulation of structural and behavioral phenotypes.
2. *Further development of idiographic principles organized into nomothetic models of behavior and cognition and their interaction with other inheritance streams over time.* Examples provided included research on how cognitive relations alter the impact of classical conditioning, or how sense of self impacts pro-sociality and cooperation.
3. *Development of reticulated models of domains, problems, interventions, and health.* Reticulated models are those that build on a mutual interaction between applied and basic approaches. Explicated examples included research on models of prejudice and stigma and ways to counteract it, or on new approaches to empowerment of social concern toward social disparities, environmental degradation, global climate change, poverty, or deprivation.
4. *Development of more adequate measurement of processes of change and behavioral outcomes.* Examples included high temporal density experience sampling methods, or measures of values attainment, quality of life, and life functioning that can be customized to fit the individual.
5. *Identification of intervention components better linked to processes and principles.* Examples included learning how to sequence psychological flexibility components for greater impact, based on individual needs, or developing specific procedures linked to evolutionary science principles, such as Ostrom's (1990)core design principles for effective prosocial groups.
6. *A broadened range of research on processes of change involved in mediation and moderation.* Examples of needed research included studies on the meditational role of changes in implicit cognition in clinical outcomes, or studies of emotional, cognitive, and overt behavioral flexibility as mediators of exposure intervention outcomes.
7. *Increased research on effectiveness, dissemination, and training.* Examples included rigorous tests of self-help books and web-sites, or of whether experiential training methods lead to greater dissemination and use.
8. *Testing applied methods more broadly and at multiple levels of analysis.* Examples included resilience training and other prevention approaches or testing the application of mental health programs based in schools, churches, or the criminal justice system.
9. *Greater focus on the development community itself.* Examples included research on how to better connect researchers to practitioners, or

how to foster research and training across a wide variety of cultures and language groups.

In this paper we are proposing a new form of functional analysis that seems applicable to CBS, as this field rises to the challenge of the COVID-19 crisis. After we have described the proposal it will be important to consider whether our proposal fits well within these features of CBS tradition. We are reminding readers of these nine features so that they can provide a context in which to review our proposal.

4. An extended evolutionary meta-model (EEMM) of processes of change

Over the past few years, a new approach to evidence-based therapy has arisen under the rubric of *process-based therapy* (PBT; Hayes & Hofmann, 2017). PBT is not a new form of therapy; rather it is a new vision for evidence-based therapy more generally. In a series of books (e.g., Hayes and Hofmann, 2018a; Hofmann and Hayes, 2020c), chapters (e.g., Hayes et al., 2020) and articles (e.g., Hayes et al., 2019; Hofmann and Hayes, 2019a), we have argued that the focus of intervention science should be on evidence-based processes of change. We define processes of change to be *theory-based, dynamic, progressive, contextually bound, modifiable, and multilevel changes that occur in empirically established sequences oriented toward desirable outcomes* (Hofmann & Hayes, 2018, p. 38). They are (Hayes, Hofmann, & Wilson, 2020):

- *theory–based,* because they are associated with clear statement of relations among events and lead to testable predictions and method of influence;
- *dynamic*, because processes may involve feedback loops and non-linear changes;
- *progressive,* because they may need to be arrange in an order to reach the treatment goal;
- *contextually bound and modifiable* to focus on their implications for practical changes and intervention kernels within reach of practitioners; and
- *multilevel*, because some processes supersede or are nested within others.

PBT is the use of evidence-based processes of change linked to evidence-based intervention kernels to ameliorate the problems and to promote the prosperity of people. As such there can be multiple forms of PBT, depending on the underlying models that summarize and systematize evidence-based processes of change (Hayes et al., 2020a). In order to establish a common ground for various models of this kind, we developed an extended evolutionary meta-model (EEMM, pronounced similarly to the word "team") that describes how to conceptualize processes of change at various levels of complexity, in order to foster consilience between various theoretical traditions. The basic psychological version is shown in Fig. 1 (Hayes et al., 2019).

Science occurs within sets of *a priori* assumptions about what constitutes data and knowledge of the world. Traditional thinking in evolutionary science is characterized by the Modern Synthesis, which emphasizes that evolutionarily significant variation arises from largely genetic mutations, that inheritance is largely genetic, and that natural selection is the primary explanation for adaptation (Laland et al., 2015). By contrast, the Extended Evolutionary Synthesis emphasizes a greater role for developmental processes, reciprocal interactions between organism and environment, the role of inheritance across multiple evolving dimensions, such as genetic, epigenetic, behavioral, and symbolic, and a renewed consideration selection occurring simultaneously at multiple levels of organization (Jablonka & Lamb, 2014; Laland et al., 2015). The core idea behind the EEMM is that we can integrate all processes of change known in behavioral science into a multi-dimensional, multi-level extended evolutionary synthesis, beginning with processes that are known to be functionally important to psychological outcomes as identified by mediational analysis. The key evolutionary principles involved can be organized around six key concepts summarized by the acronym VRSCDL (roughly pronounced "versatile"): variation and retention of what is selected in context in the right dimension and level (Hayes, Stanton, Sanford, Law, & Ta, 2020a). The EEMM asks researchers and practitioners to consider all relevant dimensions and levels in terms of the variables that promote variation, selection, and retention in context (for a book length discussion of the link between behavioral and evolutionary science see Wilson & Hayes, 2018). Although any dimension or level of analysis that applies to life functioning can be examined in this way, the basic psychological version of the EEMM considers both maladaptive and adaptive processes, organized across six psychological dimensions (affect, cognition, attention, self, motivation, and overt behavior) nested within two additional levels of analysis (sociocultural and biophysiological). Such complexity requires a different analytic approach. The "levels" of the EEMM cross scientific disciplines, while dimensions reflect different phenomena within psychology as a discipline. Orienting functional analysis toward

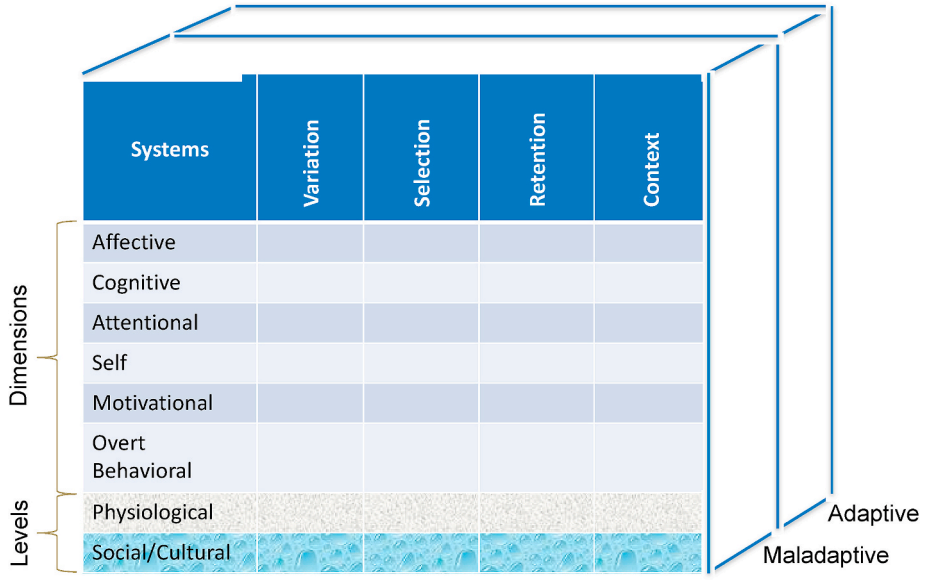

Fig. 1. The extended evolutionary meta-model of processes of change (© Steven C. Hayes and Stefan G. Hofmann. Used by permission).

an explicitly multi-dimensional and multi-level process-based approach allows us to incorporate findings across the empirical spectrum, while also promoting consilience between disciplines.

We argue that the EEMM can in essence serve as the structure of a new approach to diagnosis (Hayes et al., 2020), when linked to a process-based approach. The EEMM is deliberately set up to be universally applicable to any relatively comprehensive model of psychological problems and their amelioration. It avoids all appeals to syndromes or latent disease entities.

Since this article is focused on readers of the *Journal of Contextual Behavioral Science*, we will discuss that vision using the psychological flexibility model that underlies Acceptance and Commitment Therapy (ACT; (Hayes et al., 2012), while also giving examples of how processes that originated outside of that model can be included in functional analytic results.

The psychological flexibility model can be thought of as a kind of "proof of concept" of a process-based vision (Hayes, 2019). The six core flexibility processes are shown in Fig. 2 and their corresponding inflexible versions are shown in Fig. 3. As can be seen, the six processes typically presented in the "ACT Hexaflex" are here arranged in the corresponding psychological dimensions of the psychological EEMM. Because of the vast body of work on psychological flexibility (see Hayes (2019) for a recent book length review), only enough features of that model will be described in this article as to make sense of how the EEMM works. Variation in this context refers to the ways in which psychological adjustments or behaviors (using the term "behavior" in its broadest way) differ in their topographical and functional properties, while selection refers to consequences supplied by the environment that tend to increase or decrease a particular psychological or behavioral variant (for an in-depth review of evolutionary theory, see Wilson, 2007). Reinforcement is an example of such a behavioral selection process. Context refers to the historical and situational features that determine whether a given variant will be selected. Retention refers to the likelihood of a variant being maintained in a person's repertoire.

As the four columns are considered, in all rows of the EEMM there is a dialectic relationship between variation and selective retention. Healthy variation is not unlimited or chaotic – it is linked to context and purpose. Conversely, selective retention reduces variability, but if these aspects of evolving systems are properly context sensitive, that reduction in variability fosters adaptation. In a psychological flexibility

<table>
<tr><td></td><td colspan="4">Adaptive</td></tr>
<tr><td></td><td></td><td>Healthy Variation</td><td>Selection Criteria</td><td>Retention</td><td>Context</td></tr>
<tr><td rowspan="6">Psychological dimensions</td><td>Cognition</td><td>Defusion and cognitive flexibility</td><td>Functional coherence</td><td rowspan="4">Broaden and build using practice, and integration into larger habit patterns</td><td rowspan="2">Use conscious attention to maintain balance and effectiveness</td></tr>
<tr><td>Affect</td><td>Acceptance and emotional openness</td><td>Feeling fully</td></tr>
<tr><td>Self</td><td>Perspective taking sense of self</td><td>Belonging in Consciousness</td><td rowspan="2">Key strength of these processes</td></tr>
<tr><td>Attention</td><td>Flexible, fluid, and voluntary attention to the now inside and out</td><td>Voluntary orientation</td></tr>
<tr><td>Motivation</td><td>Values</td><td>Meaning by choice</td><td rowspan="2">Key strength of these processes</td><td rowspan="2">Use conscious attention to maintain balance and effectiveness</td></tr>
<tr><td>Overt Behavior</td><td>Committed action</td><td>Competence</td></tr>
<tr><td rowspan="2">Other Levels</td><td>Socio Cultural</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Bio Physiological</td><td></td><td></td><td></td><td></td></tr>
</table>

Fig. 2. Adaptive forms of psychological flexibility processes cast in terms of the psychological extended evolutionary meta-model.(© Steven C. Hayes. Used by permission).

	Maladaptive				
		Rigidity or Unhealthy Variation	**Selection Criteria**	**Retention**	**Context**
Psychological dimensions	**Cognition**	Fusion	Being right: Literal coherence	Broaden and build using practice, and integration into larger negative habit patterns	Attend to threats but otherwise show limited context sensitivity
	Affect	Experiential avoidance	Feeling "good" leading to a "happy numb"		
	Self	Conceptualized Self	Belonging through conceptualized specialness		
	Attention	Rigid attention past or future	Involuntary orientation		
	Motivation	Self-gratification or external "success"	Meaning by imposition		
	Overt Behavior	Impulsivity, inaction, or avoidant persistence	Short term behavioral gains at the cost of long term competence		
Other Levels	**Socio Cultural**				
	Bio Physio-logical				

Fig. 3. Maladaptive forms of psychological inflexibility processes cast in terms of the psychological extended evolutionary meta-model. (© Steven C. Hayes. Used by permission).

model, adaptation is not just understood in terms of biological health or social functioning (the levels of analysis in which psychological events are nested). Adaption is also measured against chosen values or overall life purposes as overriding selection criteria at the psychological level for all psychological dimensions, and by the accomplishment of the more specific underlying motivational operations that surround the various dimensions of human experience.

A vast literature supports the view that people have certain basic needs or yearnings beyond mere health and survival (Deci & Ryan, 2000). These are satisfied over the longer-term fashion by adaptive processes, while maladaptive processes meet them only in a short-term way and at the cost of long term outcomes.

Consider openness to affective states, as an example. People do not have to be taught for sensations and feelings to function as reinforcers. As people acquire the ability to cognitively judge their affective states, however, if cognitively evaluated negative affect occurs at a sufficiently intense level to be avoided or positive affect occurs at a sufficiently intense level to be clung on to, they may enter into self-amplifying feedback loops that narrow the range and role of affect in action. Either of these forms of affective rigidity can become harmful (Chawla & Ostafin, 2007; Sahdra, Ciarrochi, Parker, Marshall, & Heaven, 2015). When experiential avoidance, for example, is deployed as a pervasive attempt to try to feel only "good" things, it tends to amplify negative affect (for an experimental demonstration with social anxiety see Asher, Hofmann, & Aderka, 2020). It is not that avoiding negative affect is *always* maladaptive – it is rather that in some conditions the combination of selection and retention processes (including those impacting other dimensions and levels of life functioning), produce unhealthy forms of context insensitive affective rigidity that interfere with desired outcomes.

We have just given an example of how thinking in terms of an extended evolutionary account can be linked to the beginnings of a more robust form of functional analysis. Each psychological adjustment needs to be examined within a complex network of evolving features that define the functions of these adjustments.

It worth noting that psychological dimensions have also a phylogenetic history (a history of being inherited across or within species) that needs to be examined for the sake of a consistent account across levels of analysis. Functional analysis will necessarily be focused more on immediate maintaining conditions but that does not mean that the phylogenetic history should be set aside. The EEMM is not a blank slate.

For example, the importance of the yearning for relatedness or belonging is grounded in our evolutionary history in phylogenetic time scales as social primates and is plausibly related to a variety of human

behavioral and physical phenotypic features (Tomasello, Hare, Lehmann, & Call, 2007). It has been argued that perspective taking, joint attention, social referencing and similar skills that evolved due to multi-level section operating on the actions of small groups, established the conditions for the bidirectionality of human higher cognition and symbolic meaning an extension of human cooperation (Hayes & Sanford, 2014). The need to be oriented toward danger or possible access to positive resources is even more ancient, as is the yearning to become competent or to exert some degree of autonomous control over the environment – these are feature of the actions of most complex organisms that have evolved since the Cambrian period (Ginsburg & Jablonka, 2010). Our point is that the EEMM links the analysis of contemporary functioning to the kinds of topics studied in ethology, behavioral biology and traditional evolutionary psychology. The EEMM applies to all aspects of an extended multi-dimensional, multi-level evolutionary synthesis.

As is shown in Fig. 2, as we turn clinical attention to retention and context sensitivity, some psychological dimensions are more important than others in a functional account when adaptive processes are being considered. Conscious attention can increase context sensitivity, for example, and deliberately constructing values-based habits are key to the retention psychologically flexibility skills across psychological dimensions. Inflexibility processes still rely on the development of habits, but they are not linked to values and the role of context becomes more constrained. Thus, in the network of relations that constitute the application of the EEEM to functional analysis, it is helpful to consider how psychological dimensions interact to lead to ingrained patterns.

This same approach can be extended socially to couples and relationships (an adaptive version of a dyadic EEMM is shown in Fig. 4). For example, although defusion and acceptance may promote healthy cognitive and affective variation at the individual level, these skills can be extended into communicating in ways that establish mutual understanding and compassion and thus healthy cognitive and affective variation at the level of interpersonal dyads. As an intervention focus shifts to other level of analysis (e.g., from the individual to the interpersonal), the specific dimensions of that particular level become more apparent and are nested within alternative levels. An even bigger step can be made from dyadic relationships to small groups and groups of groups such as in the Prosocial program (Atkins et al., 2019). Prosocial combines psychological flexibility Elinor Ostrom's Nobel Prize winning "core design principles" (CDPs) that emerge only at the level of small groups. In essence, her first six CDPs (purpose and membership, equity, agreed upon decision making, monitoring, graded consequences, fast and fair conflict resolution) are adaptive dimensions of small group functioning, and the last two CDPs (freedom to create the group; relationships to other groups) are levels in which these dimensions are nested. It is thus easy to create an EEMM based on these CDPs as attention moves to the higher organizational level of small groups.

At a lower level of organization, the psychological EEMM also includes a sub-organismic biophysiological level and it too be dimensionalized by considering the role of genes, epigenes, organ system, brain circuits, and the like. As that focus is adopted, it is also is nested in an additional level of analysis, namely the ecosystem of an individual human body (e.g., the gut biome that impacts on these biophysiological process).

In essence the EEMM conceptualization organizes the features of an extended evolutionary account for conceptual and applied purposes. Our larger point in briefly describing these aspects of the basic approach is to note that the EEMM is deliberately set up so as to be relevant across levels of analysis within the life sciences, even though the psychological EEMM is the most important for present purposes. Exploring connections across levels of complexity goes well beyond the bounds of the present paper, but for a functional analyst conditions may arise that require such shifts in focus. The consilience provided by evolutionary theory allowed work at the psychological level to be integrated with the life sciences more generally without reductionism or expansionism.

We will return to the methodological and informational implications of the extended evolutionary meta-model after turning our attention to

<table>
<tr><td></td><td colspan="4">Socially Extending Adaptive Psychological Flexibility Dimensions</td></tr>
<tr><td></td><td></td><td>Healthy Variation</td><td>Selection Criteria</td><td>Retention</td><td>Context</td></tr>
<tr><td rowspan="7">Group dimensions</td><td>Cognition</td><td>Mutual understanding</td><td>Functional coherence</td><td rowspan="4">Broaden and build using practice, and integration into larger patterns</td><td rowspan="2">Use conscious attention to maintain balance</td></tr>
<tr><td>Affect</td><td>Compassion</td><td>Feeling</td></tr>
<tr><td>Self</td><td>Attachment and conscious connection</td><td>Belonging</td><td rowspan="2">Key strength of this process</td></tr>
<tr><td>Attention</td><td>Joint attention</td><td>Orientation</td></tr>
<tr><td>Motivation</td><td>Shared values and acknowledgment</td><td>Meaning</td><td rowspan="2">Key strength of these processes</td><td rowspan="2">Use monitoring to detect maintenance of values based commitment</td></tr>
<tr><td>Overt Behavior</td><td>Shared commitments</td><td>Competence</td></tr>
<tr><td rowspan="2">Other Levels</td><td>Groups of groups</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Psychology</td><td></td><td></td><td></td><td></td></tr>
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Fig. 4. Social extensions of adaptive psychological flexibility processes organized into a dyadic extended evolutionary meta-model. (© Steven C. Hayes. Used by permission).

the main topic of this paper: how we can make use of our knowledge of processes of change to reestablish functional analysis as a key focus of applied behavioral science. We will then be in a better position to consider some key topics present by the COVID-19 crisis as a kind of test bench for applications of the EEMM as a strategic guide for behavioral science research.

5. An extended evolutionary form of process-based functional analysis

The EEMM can be informed by any coherent and reasonably comprehensive model of intervention for which processes of change are known. By opening the door to the broad use of empirically established processes of change the meta-model can be used to define and conduct a new form of functional analysis, that considerably alleviates the weaknesses of classical functional analysis. What follows is a brief outline, but more extended treatments are coming (Hofmann, Hayes, & Lorscheid, in preparation; see also Hayes, 2020).

What we will call here *process-based functional analysis* applies the EEMM in the following steps.

1. *Primarily relying on the client's report of the central problems or unmet aspirations, identify potentially relevant characteristics of the individual client, his or her behavior and subjective experiences, and the context in which they occur* via *broad assessment organized* via *the extended evolutionary meta-model.*

It is important to avoid the use of syndromal terms and concepts in functional analysis, including even such ubiquitous terms as "symptoms" or "disorders." People have learned to say "I have depression" for example, but once that is said, a focus on the actual events of interest (for example on mood or behavior) tends to diminish. Thus, the first step in this form of functional analysis needs to be driven by more direct information, supplemented by broad assessment. The EEMM can be used to guide questions and measures as the possible relationships among events are examined. By considering each dimension and level, and the issues of variation and selective retention in context, a broad filter can be applied to initial information gathering that sets the stage for a process-based account.

We have found it useful to lay out the features of the case in a network and to specify the direction and strengths of relationships between elements in the maintaining conditions. The complex network approach models the elements of a problem as interrelated elements of a system (Hofmann, Curtiss, & McNally, 2016). Each item is represented as a 'node', with the relation between nodes referred to as 'edges' although we will also simply use the term "relations." Edges can to unidirectional or bidirectional. Central nodes refer to those that relate significantly to multiple nodes throughout the network, while sub-networks refer to clusters of mutually inter-related nodes within the larger network (see Hofmann et al., 2016 for an overview of foundational terms in complex network analysis). Network approaches have the potential to transform the way we understand the relationships between psychological events in context and to move psychotherapy into the world of personalized medicine (Rubel, Fisher, Husen, & Lutz, 2018;

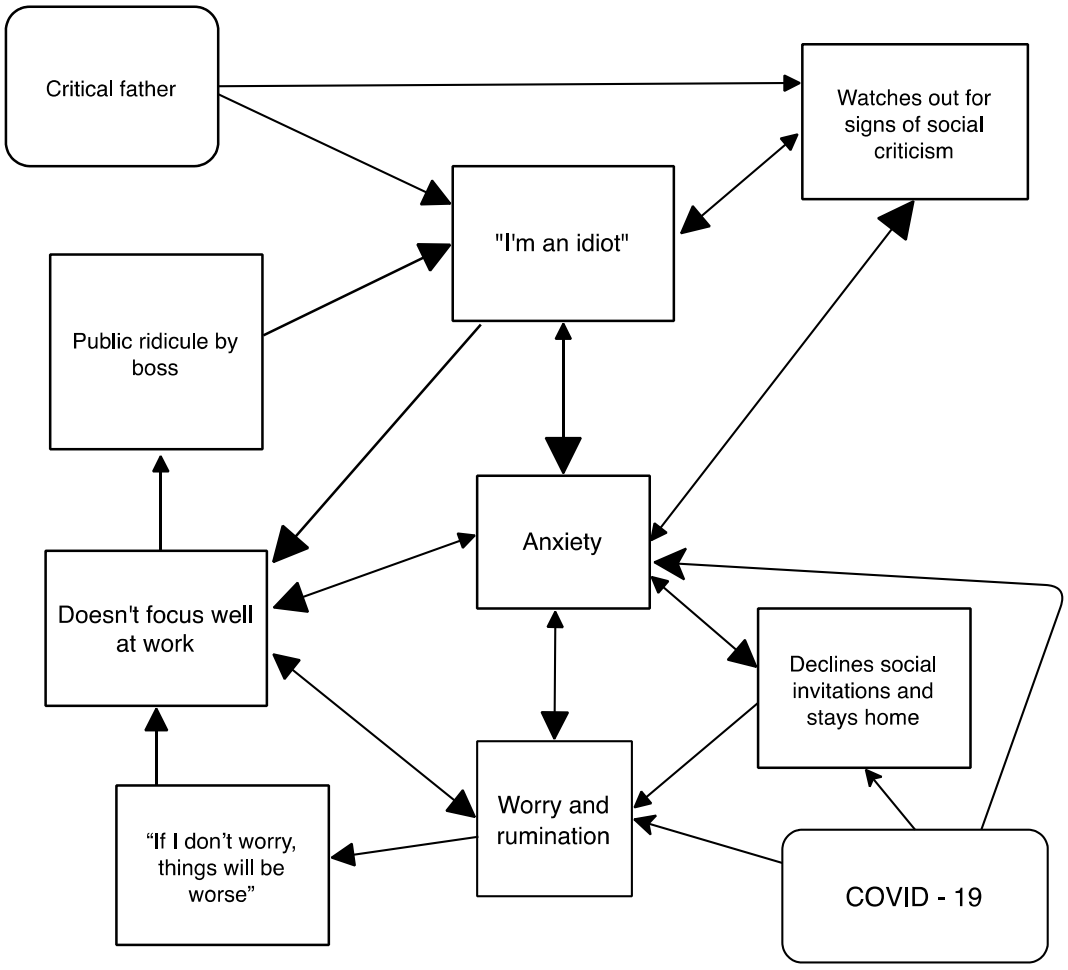

Fig. 5. An example of a network-based organization of a case of an individual struggling with anxiety, worry, and self-concept issues due to a critical history and work environment, exacerbated by anxiety linked to COVID-19. Larger arrowheads indicated stronger relations.

Fisher et al., 2019). A practical example of a female office worker dealing with overwhelming anxiety is given in Fig. 5. At this stage the network is intentionally descriptive and is not yet deliberate organized into processes of change.

2. *Organize that information into a preliminary analysis that is responsive to the extended evolutionary meta-model and is expressed both in terms of origin and especially in terms of maintaining conditions, so as to identify important functional relationships that might be changed during the process of the intervention.*

In the next stage, knowledge of processes of change, informed by the underlying EEMM-based analytic model, can be applied to the preliminary network. For example, in an ACT based psychological flexibility model, relationships among elements that might reflect processes such as cognitive fusion, inflexible attention, or the domination of a conceptualized self can be examined more closely. The focus should be particularly on possibly self-amplifying aspects of the network. These are possibly present whenever relationship between elements or dimensions are bi-directional or enter into closed loops in sub-networks. For example, suppose the network shown in Fig. 5 combines attentional vigilance toward threats to a conceptualized self, anxiety in response to such threats, and even more vigilance. That sub-network can readily self-amplify, especially if other features of the case are maintaining a rigidly defended persona and anxiety, because it loops back on itself. For example, the facing a COVID-19 challenge quite naturally might foster anxiety, but that in turn may engage a self-amplifying process due to other functional relations engaged by felt anxiety. Self-amplification is a common feature of what we call psychopathology and thus deserves special attention in process-based functional analysis.

As empirically established processes of change are applied using the initial orienting model, this form of functional analysis easily and naturally opens the door to additional change processes. For example, although cognitive fusion is likely a central concern of any ACT therapist, it is not a large step to consider the inability to generate alternative conceptualizations as well. Reappraisal skills are known to be intertwined with defusion skills (Krafft, Haeger, & Levin, 2019) and thought of as a form of cognitive flexibility, cognitive reappraisal as a process can readily be included as an aspect of functional analysis as driven by the psychological flexibility model.

Using the EEMM to guide functional analysis lowers barriers between traditions, and naturally encourages more flexible use of processes of change originally developed and targeted within other models. This openness also allows more consideration of issues at the level of phylogenetic history, as well as personal history. Regardless of their source, as possible processes of change are identified, the network itself often is rearranged.

3. *Gather additional information that will inform the preliminary functional analysis and after adding repeated measurement data on the hypothesized*

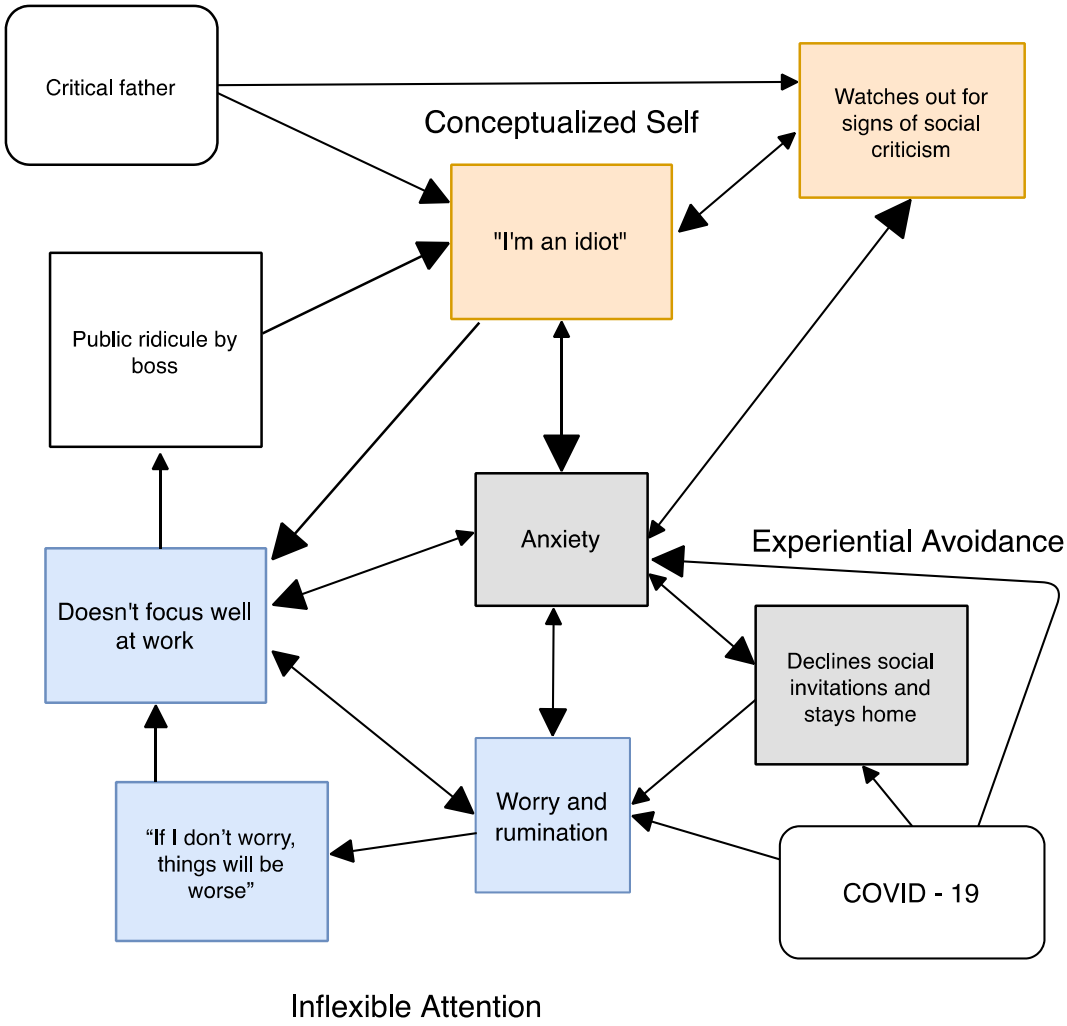

Fig. 6. An example of a preliminary process-based functional analysis of a case of an individual struggling with anxiety, worry, and self-concept issues due to a critical history and work environment, exacerbated by anxiety linked to COVID-19. Larger arrowheads indicated stronger relations.

primary processes of change if possible. Based on that data reconsider the network, including modifications that emerge in light of nomothetic prototypes drawn from previous functional analytic work.

A hallmark of functional analytic thinking is the collection of repeated measures. This is a necessity in process-based work, and especially so in functional analysis. Ecological momentary assessment (EMA) represents an approach to repeated, high density measurement that holds considerable promise (Stone & Shiffman, 1994; Trull & Ebner-Priemer, 2009, 2014; Vilardaga, McDonell, Leickly, & Ries, 2015). Using higher density longitudinal EMA data focused on possible processes of change and their context allows the hypothesized relationships in the preliminary functional analysis to be subjected to empirical examination (e.g., Fisher et al., 2019). As formal data on hypothesized processes are gathered, the network should be reorganized to show the directionality and strength of interrelationships. All processes of change can apply at this step, but all should have been previously shown (most often through mediational analysis) to be possible functional important pathways of change. This next step is shown with our hypothetical case in Fig. 6.

4. *Devise an intervention strategy based on the refined functional analysis that sequentially targets key features of the network that can be changed, and that can lead to an adaptive self-sustaining network by weakening maladaptive features and strengthening adaptive features.*

There are a number of key considerations in picking treatment targets in process-based functional analysis. Ultimately the most central maladaptive processes will need to be changed. In network analysis nodes, relations, or sub-networks of central importance are indicated by the number and strength of relationships they maintain (conceptually and especially empirically) with other problematic nodes, relations, or sub-networks. It may not make good strategic sense, however, to directly target the most central processes first. There may be a central issue that the client won't allow to be targeted until progress in other areas is made. For example, a client may have emotional reactions centered on trauma, but as soon as the client is aware of them, they feel overwhelmed by self-judgment or shame (e.g., "I'm bad"). In that case, cognitive flexibility skills or a change in sense of self might need to be targeted first to provide the flexibility skills needed for direct work (e.g., exposure) linked to the core negative affect. Other such practical considerations come into play as well, such as client strengths that can be used, limitations due to the setting, or practitioner skill.

Strategically there are additional concerns. The analysis needs to consider whether the first treatment kernels deployed will perturbate the system sufficiently to be able to change the interlocking set of relations that maintain the maladaptive state of the system. This is key because networks tend to be self-sustaining and self-replicating. The "creative hopelessness" phase of ACT work is specifically designed to destabilize the overall maladaptive networks of clients as a foundation for further work. When the low workability of current actions is clear, and these responses are discriminated as being part of oneself in awareness (in RFT terms, they are frame dhierarchically with a deictic "I"), confronting psychologically inflexible habits of mind and behavior strongly motivates psychological change (Törneke, Luciano, Barnes-Holmes, & Bond, 2015). Thus, creative hopelessness destabilizes current maladaptive networks in the service of seeking greater psychological flexibility.

Good treatment targets also tend to open up options for next useful steps. Thus, treatment planning may deliberately focus on smaller and easier steps that will, if successful, empower bigger or more difficult steps down the road. For example, although anxiety is the most central node in the client shown in Fig. 6, it might be better to focus on a building a perspective taking sense of self first, perhaps through mindfulness exercises. Anxiety is being impacted strongly by COVID – 19 concerns in this case, which may make it harder to target initially without becoming entangled in the ups and downs of the pandemic. Conversely, changes in attachment to a conceptualized self could help with the anxiety issue but also set up further work on attentional focus. Together those change in the network would set a strong foundation for addressing the most central but also the most complex node of anxiety and the additional emotional flexibility process it engages.

A prime consideration in any functional analysis that is likely to have treatment utility is that the analyst should be able to envision a new network of relations that are self-sustaining while addressing the main purpose of the intervention. In other words, the same skills involved in creating a process-based functional analysis in the client understanding and planning phase that addresses maladaptive variation and selective relation in context, now needs to be focused on the maintenance and generalization of gains. In the case of the client we are discussing, that might include adding values work linked to positive social involvement and self-compassion, allowing anxiety and self-concept issues to be channeled into positive behavior change. For example, a client like this might be uplifted by volunteer work linked justice and equity efforts especially if focused on socially stigmatized or disempowered persons that relate in some way to his own history of criticism and of unfair treatment. Suppose she cares about the impact of harsh working environments and prejudice on disadvantaged workers and their children and becomes part of an outreach social support program for children of migrant workers. This goal and its place in the functional relations sustained by this client is shown in Fig. 7. In this terminal network, anxiety and worry is still an issue but less so over time as mindful self-compassion and values based action take center stage in a self-amplifying way, inhibiting the negative impact of criticism, anxiety, and worry, and channeling attention to the now into positive psychosocial change.

5. *Implement treatment kernels and assess perturbation of the network and process-level change.*

In this phase of process-based functional analysis, the key information is what is known about how to move processes of change via treatment kernels. In the current research environment those will be addressed by treatment moderation, mediation, and components. A fair amount of information exists in the treatment literature, and specifically in the area of the psychological flexibility model, regarding processes of change (Hayes et al., 2019; Hayes & Hofmann, 2018a), treatment components (Levin, Hildebrandt, Lillis, & Hayes, 2012, and research on how these components move processes of change (e.g., Villatte et al., 2016). An advantage of process-based functional analysis as compared to classical functional analysis is that by using evidence-based processes change that have previously been shown to mediate outcomes, as is the cast with psychological flexibility processes, the analyst has reason to believe that continuing with the treatment plan in a step by step fashion is likely to be successful when process changes are detected. Conversely, if targeted processes do not change, immediate feedback is available to suggest the need to reconsider the entire functional analysis. Outcome changes are the ultimate arbiter, but they can be delayed and at times they can be forced via means that are not viable in the long term, creating false forms of feedback. By definition, mediators of change are predictive of long-term outcomes over and above incremental changes in outcomes and thus are more reliable proximal guides to the value of functional analyses. As treatment continues to be applied, however, the next step in process-based functional analysis can be taken.

6. *Assess subsequent outcome movement based on expected link between process and outcome.*

As time passes the adequacy of a functional analysis is indeed determined by outcome. The empirical literature can give guidance regarding how much time should pass, but once it does if outcome level changes are supportive, and progress is still occurring, staying the course

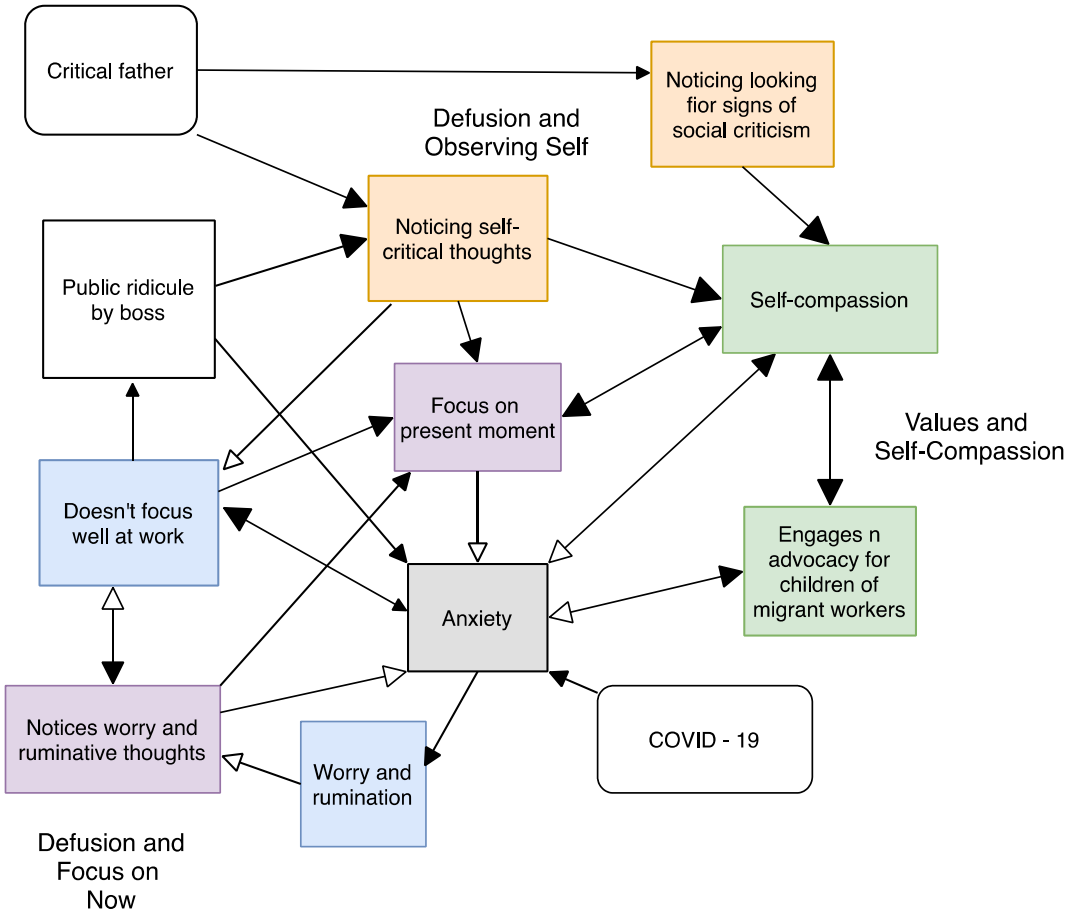

Fig. 7. An example of a treatment goal in a case of an individual struggling with anxiety, worry, and self-concept issues due to a critical history and work environment, exacerbated by anxiety linked to COVID-19. Larger arrowheads indicated stronger relations. Open arrowheads indicate inhibitory relations.

with the treatment plan makes the most sense. Otherwise, the analysis needs to be reconsidered and a new strategy for progress needs to be developed.

7. *Attempt to nest idiographic analyses of processes, treatment, outcomes into nomothetic prototypes.*

Collecting and using the results of any form of functional analysis is the most difficult current step because of the domination of group comparison methods that make process-based research difficult (Hayes et al., 2019). Traditional group comparison statistical methods are based on an assumption that the structure of between-individual variation is equivalent to within-individual variation. The physical sciences have known for nearly 100 years (based on the established mathematics of the "ergodic theorem; " Krengel, 1985) that such assumptions apply to very few physical events. Statistical violation of the ergodic theorem is nearly universal in applied psychology (Molenaar, 2004) because psychological processes are inherently idiographic by their very nature. The fiction of the "homogeneity of the study population," based on a shared syndrome, papered over this problem, but it is laid bare for all to see once processes of change are the focus. This is one reason it is becoming increasingly clear in the larger clinical science community that it is improper to make an ergodic assumption regarding psychological data because the distribution of scores in a population simply cannot model the distribution of scores for individuals over time (Molenaar, 2004). This means that when examining processes that unfold over time, person specific data analysis needs to become the new normal (Molenaar, 2013). For that reason, EMA and single subject methods are the natural partners of a search for process-based knowledge (Vilardaga, Bricker, & McDonell, 2014). To facilitate the adoption of these approaches, it will be necessary to integrate technology and data analytic strategies that simplify the data collection and interpretation challenges faced by clinicians. Collecting and analyzing these data via paper and pencil measures would likely overwhelm the practitioner. However, there are already tools such as smartphone-based apps and automated data analysis procedures that simplify the implementation of our suggestions (see, for example, a free app called "nudgelearning"). In addition, practitioners will need to be trained in the processes of change that emerge from this kind of data collection, but this training is already emerging as a viable strategy (Hayes & Hofmann, 2018a; 2018b).

Intensive sampling methods come in many varieties, with their own methodological challenges (Bentley, Kleiman, Elliott, Huffman, & Nock, 2019; Moskowitz, Russell, Sadikaj, & Sutton, 2009; Ram, Brinberg, Pincus, & Conroy, 2017), and a further challenge is arriving at nomothetic generalizations that maintain contact with process knowledge. Fortunately, idiographic approaches are being developed that allow nomothetic generalizations to emerge in a legitimate way from idiographic data (e.g., Gates & Molenaar, 2012), but much more remains to be done.

6. Functional analysis reimagined

A process-based form of functional analysis linked to the EEMM, plays directly to six of the nine key features of the CBS research tradition reviewed earlier. This approach to diagnosis is explicitly based on connection with multi-dimensional and multi-level evolutionary science, and the development of idiographic principles organized into nomothetic models. It involves both basic and applied research, linked

to processes of change and behavioral outcomes and the treatments that produce them. Finally, it takes seriously the data on mediation and moderation. All of these were stated to be foundational to the analytic strategy of CBS research (Hayes, Barnes-Holmes, & Wilson, 2012) and were repeated earlier in this article. Thus, we argue, process-based functional analysis is ready to be used by the CBS community as a step that fits with its developmental trajectory.

It also corrects the known problems with classical functional analysis, or the limitations of empirical standard functional analysis in applied behavior analysis. The EEMM specifies the key dimensions of initial assessment *a priori*, and by relying on the modern evidence on processes of change, such as that drawn from mediational analysis, process-based functional analysis both expands beyond direct contingency principles and yet limits the set of principle that can be applied to a more manageable level. It is that expansion that most warrants the new term "process-based functional analysis." Functional analysis was always based on principles, but as a set "processes of change" as defined within process-based therapy go far beyond direct contingency principles. Finally, this approach provides more detailed guidelines for how to move from the early stages of functional analysis to intervention recommendations and gives a way for the field to continuously analyze and improve the adequacy of functional analysis itself.

Major challenges do need to be solved, such as the refinement of a dynamically sensible view of mediation (Hofmann et al., 2020) that can be applied idiographically (Hayes et al., 2019). Options for pooling the statistical outcomes of multiple SSDs have never been as prevalent as now (Lanovaz & Rapp, 2016; Shadish, 2014) but new ways of embedding single subject methods within randomized controlled trials are also needed (i.e., Hayes, Levin, Plumb-Vilardaga, Villatte, & Pistorello, 2013). Idiographic analyses can take other forms as well (Piccirillo, Beck, & Rodebaugh, 2019), such as exploratory and confirmatory *P*-technique factor analysis, which function similar to traditional factor analytic techniques (except for being centered on individual distribution of scores over time), and dynamic factor modeling (a form of structural equation modeling that assesses contemporaneous correlations and time-lagged regressions; Fisher, 2015).

Network analysis is not yet able fully to address trends over time and thus the use of statistical models such as GIMME (Gates & Molenaar, 2012) for the development of idiographically-based nomothetic prototypes in intervention research requires difficult compromises. Still, the identification of functionally important pathways of change as the focus of intervention research has just begun, and the foundational method of functional analysis deserves to become a central topic once again. We now have enough tools and data in hand to return the idea that functional analysis can serve as a key methodological tool in dealing with novel situations in a way that draws from the past but also that propels the field into the future.

And here we return to the COVID-19 crisis. We do not know if COVID -19 will be a problem a year from now, or ten years from now. Regardless, as we step up to the challenge of the present, we need to do so in a way that serves the future. In our view, a focus on processes of change in general, and the use of an extended evolutionary approach to process-based functional analysis in particular, gives every hope of doing just that. We will review the following content areas as examples of the applicability of an EEMM approach. Our point is not that these are wholly separate problems that need their own analyses, but rather that they orient us to the natural priorities if the CBS approach. One size does not fit all, and different content areas will naturally pull for different applications of the EEMM.

7. The COVID-19 challenge: three examples

7.1. Trauma

The COVID-19 crisis is suddenly presenting the world community with potentially trauma inducing events. Millions of people have engaged in a life-or-death struggle with the virus itself, but many millions more than watched family or friends combat the disease. Persons in jobs as diverse as healthcare, policing, or meat packing go to work knowing that their lives are on the line. Entire communities have been virtually house-bound for months on end.

We know some of the change processes that are predictive of the development of posttraumatic stress from a wide variety of potentially trauma-inducing experiences, and often they are the same processes changed in successful treatment programs focused on trauma. Experiential avoidance and other psychological flexibility processes are known risk factors for the development of stress after such a wide range of potentially trauma inducing events (e.g., Brockman, Snyder, & DeGarmo, 2016; Gold, Marx, & Lexington, 2007; Kumpula, Orcutt, Bardeen, & Varkovitzky, 2011)., that it can be reliably predicted that the impact of COVID-19 will be mediated in part by these processes (Orcutt, Reffi, & Ellis, 2020, pp. 409–436). For example, in a longitudinal study conducted at a college campus before and after a school shooting, female students with higher levels of experiential avoidance before the shooting were more likely to develop stress related problems afterward (Orcutt, Bonanno, Hannan, & Miron, 2014, pp. 249–256). The same was shown for Air Force convoy operators deployed to Iraq and Afghanistan, across a wide range of problems including stress, depression, and risk for suicide up to a year post-deployment (Bryan, Ray-Sannerud, & Heron, 2015). Among returning veterans from Iraq and Afghanistan psychological flexibility was a unique predictor of trauma related resilience when controlling for personality factors and self-reported trait resilience (Meyer, Kotte, et al., 2019). In a sample of U.S. adults exposed to possibly traumatic events, valued living moderating the relationship between post-traumatic stress and functional impairment (Donahue, Khan, Huggins, & Marrow, 2017). A large body of similar findings relate to the impact of retroactively assessed early life trauma (e.g., Richardson & Jost, 2019). These responses are likely to be socially transmitted since parents' psychological flexibility predicts the trauma of their children when experiencing crises of this kind (Polusny, Ries, & Erbes, 2011).

As with high levels of social anxiety and other forms of negative affect (Asher, Hofmann, & Aderka, 2020) experiential avoidance and post-traumatic stress influence each other in a bidirectional relationship (Badour, Blonigen, Boden, Feldner, & Bonn-Miller, 2012). When treatment is able to reduce experiential avoidance and increase psychological flexibility that self-amplifying cycle is broken, and with it the selection and retention processes that turn potentially trauma-inducing experiences into traumatic outcomes. That has been show with veterans returning home from war (Meyer et al., 2018), which women facing a history of interpersonal victimization (Fiorillo, Mclean, Pistorello, Hayes, & Follette, 2017), with survivors of colorectal cancer (Hawkes, Pakenham, Chambers, Patrao, & Courneya, 2014), or with South Sudanese refugees escaping war (Tol, Leku, & Musci, 2020). Indeed, the data suggest that if these processes of change are managed properly, contacting potentially trauma-inducing events can lead to post-traumatic *growth* and increased quality of life (Hawkes et al., 2014).

As researchers face the potential trauma inducing impact of the COVID-19 crisis they can combine what is known with a process-based functional analytic strategy to learn more about how trauma works and how it can be prevented or treated. For example, we know that traumatic events are multi-level and multi-dimensional phenomena, in the sense that they 1) evoke psychobiological reactions, and 2) evoke parasympathetically mediated states such as freezing, which in turn can drive variability of trauma symptoms (Baldwin, 2013). These processes at the bio-physiological level of the EEMM in turn can interfere with psychological dimensions, especially attentional and cognitive process, altering how fear functions.

Detailed functional analyses that combine cognitive, affective, attentional, and neurobiological measures would allow the identification of idiographic patterns linking fear responses to processes of change. Fear based emotional responses originate in evolutionarily 'old' brain circuits and can be established phylogenetically or learned in vivo

or by observation (Cantor, 2009). Symbolic processes of the sort examined in studies of derived relational responding can hijack far more ancient survival circuits and lead to unwanted forms of fear generalization or to sustained and harmful forms of vigilance and attention to possible threat (Dymond, Bennett, Boyle, Roche, & Schlund, 2018). These processes have been shown by contextual behavioral scientist in a variety of well controlled laboratory and clinical studies of direct relevance of the COVID-19 crisis (Presti, McHugh, Gloster, Karekla, & Hayes, 2020). Idiographic functional analysis could allow the field more quickly to understand how this happens and for whom. For example, we have previously argued fear generalization due to implicit cognition (e.g., Levin, Haeger, & Smith, 2017) is especially likely to be pernicious (Hayes and Hofmann, 2018b). It that is true it needs to be targeted in interventions designed to alter fear and trauma for those with affectively laden brief immediate cognitive responses to potentially trauma inducing events, more so than for others without these implicit responses. The pervasive impact of COVID-19 is an ideal opportunity to explore the treatment utility of process-based interactions of this kind. Intervention kernels known to alter implicit cognition could be differentially applied to those whose functional analysis suggest a role for implicit cognition in trauma development.

As another example, stress reactions to traumatic events and their sequelae often center around avoidance; indeed, the best treatments for traumatic experiences all involve some form of exposure learning. From a psychological flexibility point of view, exposure involves organized contact with previously repertoire narrowing events for the purpose of producing more response flexibility. The broad human impact of COVID-19 allows researchers to consider how to amplify the utility of exposure in a more personalized way by adding features to exposure-based interventions for specific individuals based on the idiographic results of baseline functional analytic examinations. For example, we know at the collective level that self-compassion does a good job predicting recovery from post-traumatic stress in a longitudinal sample of combat-deployed Iraq and Afghanistan war veterans (Meyer, Szabo, et al., 2019), even more so than mindfulness or psychological flexibility. Idiographic functional analysis would allow a more personalized recommendation in which kernels could be combined with exposure based on the change processes shown to be most relevant to a given person from self-compassion to mindfulness to perspective taking (Christopher, 2004).

7.2. Burnout and stress

The depth and scope of psychological harm in the general population brought on by COVID-19 is only beginning to be fully understood (Gruber et al., 2020). People all over the world and of every vocation are having their routines disrupted, their employment furloughed, and their sense of well-being challenged (i.e.,Wu et al., 2020; Sasangohar, Jones, Masud, Vahidy, & Kash, 2020). Even before COVID-19, stress and burnout in developed economies was an urgent area of concern for psychological science (Bond, Hayes, & Barnes-Holmes, 2006; Maslach, 2003). Healthcare systems now recognize the long-term danger posed by burnout, stress, and such problems as moral injury (e.g., Bellingreri, 2020; Greenberg, Docherty, Gnanapragasam, & Wessely, 2020). In that context, research based on process-based functional analysis approach can make important and rapid contributions.

Research in ACT (in the non-clinical context often called Acceptance and Commitment Training or ACTraining) has shown that the core processes of ACT can be effective at increasing psychological flexibility in the workplace (for an overview and introduction to ACTraining, see Moran, 2015; for a book length manual of using ACT in the workplace, see Flaxman, Bond, & Livheim, 2013). Researchers have found a relationship between stress, burnout, and psychological flexibility processes in addiction counselors (Vilardaga et al., 2011), oncology nurses (Duarte & Pinto-Gouveia, 2017a), call center employees (Bond, Flaxman, & Bunce, 2008), college athletes (Chang, Wu, Kuo, & Chen, 2018), and representative general population samples (e.g., Gloster, Meyer, & Lieb, 2017). In addition, high density measurement methods are emerging that have found that psychological flexibility predicted lower levels of emotional exhaustion among workers longitudinally (Biron & van Veldhoven, 2012).

It is also known that methods that target psychological flexibility can make a difference in burnout and stress. For example, a randomized controlled trial of ACT targeting stress and general mental health of Swedish social workers found that the intervention was effective for individuals with high levels of stress (but not low levels of stress), and that changes in psychological flexibility correlated with changes in overall outcomes (Brinkborg, Michanek, Hesser, & Berglund, 2011). A non-randomized controlled study of oncology nurses in Portugal found that a 6-week mindfulness based group intervention significantly impacted psychological inflexibility, which in turn led to changes in burnout (Duarte & Pinto-Gouveia, 2017b). A study of U.K. government workers randomly assigned to either group-based ACT intervention in the workplace or a wait list control found that changes in psychological flexibility led to improvements in emotional exhaustion, which in term led to a reduction of depersonalization (Lloyd, Bond, & Flaxman, 2013).

As before with trauma, the literature has room for improvement. A systematic review of mindfulness-based trainings and interventions for stress and burnout found that, although interventions such as ACT can improve mindfulness and reduce stress, impact on other variables was not as consistent (Rudaz, Twohig, Ong, & Levin, 2017). The current climate of overwhelming stress in countries worldwide is an ideal time to speed up progress.

Progress will require a considerable improvement in measurement that goes beyond infrequently applied self-report questionnaires. In this area particularly, there has been an over reliance on a very few measures of psychological flexibility such as the AAQ-II, as has been pointed out by others (Reeve, Tickle, & Moghaddam, 2018). New questionnaires hold promise (e.g., Benoy et al., 2017, 2019) but functional analysis will very naturally lead to advances in this area by its emphasis on higher temporal density measurement over longer periods of time linked more closely to the details of particular human lives.

By traditional definition, coping effectiveness relies on fitting adjustments to particular contexts. Thus, process-based functional analysis will naturally put more emphasis on measurement of context. By the fact that functional analysis emphasizes longitudinal changes in the context of within person measurement variability, it naturally focuses on the development and maintenance of skills over time. Both of those effects make good sense in light of what is known about stress and burnout. Sustained engagement in behavior change after an intervention seems to matter at least as much an engagement during it. A recent study of a brief mindfulness, acceptance, and values-based intervention found that attention during training and sustained practice in the following weeks were key factors for burnout reduction (Kinnunen, Puolakanaho, Tolvanen, Mäkikangas, & Lappalainen, 2019). Interventions designed to enhance skills in psychological adjustment to stressors have found that the use of multiple strategies fitted to the challenges of any given moment are key to positive outcomes (Chesney, Chambers, Taylor, Johnson, & Folkman, 2003; Taylor & Stanton, 2007).

Process-based functional analysis driven will also help expand the psychological flexibility model itself. Coping self-efficacy is a consistent mediator with known relevance to mindfulness and emotional regulation (e.g., Luberto, Cotton, McLeish, Mingione, & O'Bryan, 2014). Viewed under the EEMM lens, self-efficacy often involves issues of self, cognition, and behavior as the person views herself as one who can deploy skills to accomplish conceptualized ends. It seems likely that individuals will vary in the other processes of change that lead to increased self-efficacy. A rigid and negative conceptualized self may apply in one case, whereas avoidance of the pain of disappointment may apply in another. That kind of process-based information is critical to fitting interventions for burnout and stress to the person, but it is unlikely to be found nomothetically first. A larger number of process-based

functional analyses with people dealing with the burnout and stress inducing features of the COVID-19 crisis can more naturally and rapidly supply such information, from which reliable nomothetic prototypes can be derived.

This makes a more general point. The COVID-19 crisis raises a myriad of important outcome areas to research, but in every case more information is needed about the exact person-specific ways known processes of change influence these outcomes. Process-based functional analysis is ideally suited to make contributions to such areas.

We know, for example, that implicit prejudice towards patients, above and beyond explicit prejudice or job satisfaction, mediates the relationship between job stress and the intention to change jobs among health care workers (von Hippel, Brener, & von Hippel, 2008). Fusion with negative labels about perceived others can narrow attentional processes (Friedman & Förster, 2010) with resulting consequences for well-being and regulation of affect. Disentangling the multiple processes involved in an issue like the stigmatizing attitudes of health care workers and resulting increases in burnout and stress, is simply not a "one size fits all" matter. Individual trajectories make a difference, and the low longitudinal measurement density and relatively weak process focus of technologically driven randomized trials cannot develop the needed information that will allow interventions to be fitted to personal needs.

Process-based functional analysis in this area might, for example, usefully consider ways of inducing variability and context-based selective retention of helpful variants. Various methods of inducing variation across cognition, affect, self, and attention could be deployed as kernels, with the goal of matching each "variation" kernel to a set of selection and retention procedures designed to promote long-term change in the network of variables. Consider how the COVID-19 crisis is impacting the stress levels and coping capabilities of healthcare workers. This immense stressor (constant use of PPE, shortages of PPE, the risk of getting the virus, worrying about transmitting it to others, etc.) can be thought of as a source of variation and selection, as healthcare workers choose adaptive (or maladaptive) responses to try to cope. As different individuals try to respond to the demands of the environment, hospital administrations respond with therapeutic interventions or promoting access to such interventions. Some health care workers might respond to defusion, others may respond better to perspective taking exercises, still others to affective regulation skills. Functional analysis could ensure that much of this could be done in the context of care, rather than in funded academic research alone. Thus, the immediate demands of a crisis could be facilitative of knowledge development rather than destructive.

7.3. Behavior change

Our final example area of many we could choose is simple and direct forms of behavior change. Controlling the spread of COVID-19 means avoiding nonessential travel, maintain physical distance with people outside of the immediate household, wearing masks in public settings, engaging in frequent hand washing, working from home, and avoiding touching our faces, among other forms of behavior change. To put it simply, people are being asked to turn their habits and routines upside down for the sake of themselves and others.

Although many people in medicine and epidemiology are providing good guidelines that we ought to follow, "good advice" on its own is rarely a powerful empirically supported intervention for significant forms of behavior change. Although other contextual variables can make health advice more salient to patients (Flocke & Stange, 2004), how to motivate individuals to engage in health behaviors remains an intensive area of investigation for medicine and psychology alike (e.g., Gipson & King, 2012; Middleton, Anton, & Perri, 2013). Even a relatively simple behavior such as hand washing with clear implications for health and disease mitigation is often the subject of experimental analysis and policy consideration in health organizations (e.g., Luke & Alavosius, 2011; Whitby, McLaws, & Ross, 2006). Although we do not have the space here to review every behavior change technique and principle, Embry and Biglan (2008) provide a useful index of evidence-based kernels to consider for implementation in a variety of settings. This functional and modular approach to organizing intervention technology is right at home in an evolutionary approach and allows existing conceptual tools and strategies (Biglan & Embry, 2013; Biglan & Glenn, 2013; Biglan & Hinds, 2009) to be deployed quickly.

This has already been done by CBS researchers in the context of the novel challenges of epidemics. During the West Africa Ebola crisis of 2014–2016 that impacted Guinea, Liberia, Sierra Leone and other African countries, an organization called *Commit and act* was working in Sierra Leone to train community members and therapists in ACT, in cooperation with the Sierra Leone Ministry of Health and Sanitation (Stew art et al., 2016; Stewart, Ebert, & Bockarie, 2017; White & Ebert, 2014). Through community trainings and empowering local leaders using ACT principles, *Commit and act* assisted in disseminating values driven behavior change that allowed communities to honor their deceased loved ones via important burial traditions, while also engaging in behaviors to minimize the spread of infection (Stewart et al., 2017). The work of *Commit and act* was fundamentally grounded the Prosocial approach mentioned earlier (Atkins, Wilson, & Hayes, 2019) which combines psychological flexibility and Ostrom's CDPs (Ostrom, 1990; 2010; see Cox, Arnold, & Tomás, 2010 for an empirical review of studies that tested the application of these principles; and White, Gregg, Batten, Hayes, & Kasujja, 2017, for a broad overview of how CBS might continue to contribute to global mental health).

Although our presentation of these ideas is new, the notion of cultural evolution is not (e.g., Jablonka & Lamb, 2014; Mesoudi, Whiten, & Laland, 2006). The development of complex relational repertoires was itself likely a social enterprise (Hayes & Sanford, 2014), and this inclusion of the social aspects of complex learning provides a more complete account of how cultures change over time as compared to modular approaches on their own (Mesoudi, 2016). Thus, impactful behavior change on a large scale will require testing and evaluating functional interventions at the scale to match. The social EEMM integrates targets for group change across several dimensions and levels, and models in other evolutionarily oriented fields may be useful tools for consideration (e.g., Derex & Mesoudi, 2020).

Although we are used to thinking of behavior change in terms of direct contingencies, we cannot ignore how social learning or meaning at the social level may be harnessed. How do people find the motivation to wear masks? Do they wear them because they're afraid of getting sick, or because they don't want to get somebody else sick? Similarly, how do individuals evaluate whether to engage in social distancing? At least in Canada, it seems that collective interest is a stronger motivator than self-interest for mask wearing behavior during COVID-19, although demographics such as gender, regional affiliation, and partisan affiliation are stronger predictors (van der Linden & Savoie, 2020). Examining previous research finds that fear, self-efficacy, and response efficacy are significant predictors of intending to engage in social distancing (Williams, Rasmussen, Kleczkowski, Maharaj, & Cairns, 2015), while another study found that social support may be a key variable for predicting implementation of infection control measures in a hospital setting (Kanjee et al., 2012; see Teasdale, Santer, Geraghty, Little, & Yardley, 2014, for a systematic review of qualitative research regarding perceptions of infectious disease interventions). The COVID-19 crisis calls out for research focused on identifying the various cognitive, affective, and motivational factors that influence the selection and retention of behaviors that are in the public good.

Research to date has given us places to start, such as in the role of perceived efficacy. How do individuals form beliefs about the worth of disease prevention efforts, and how are these beliefs shared across groups? How can we enhance valuing as a repertoire in order to drive selection of best practices? Can we enhance perspective taking such that people choose to engage in mask wearing because they "see" the person they are going to protect? By thoughtfully engaging these issues, we can

derive solutions for the current crisis while continuing to build a knowledge base of evolutionarily driven functional analysis for the future. For example, one could compare different ways of sharing information about the importance of disease preventing behaviors and the rationale for doing so (mask wearing, hand washing etc.) and capture group level data such as valuing tendencies, perspective taking, material barriers etc. This information in turn could feed network models designed to predict health attitudes or behaviors over time. Imagine someone identifying that their motivation was flagging to keep up on health precautions and delivering a targeted prompt or motivating message based on their own longitudinal data. This series of steps (gather data, form an array of possible processes, and then empirically examine how to best apply them for individuals) represents a true realization of merging the nomothetic with the idiographic (Hayes et al., 2019).

8. How novel situations can lead to lasting contributions

At the psychological level there is nothing novel about novelty. Every situation faced by a psychosocial practitioner is, in some sense, unique. What allows psychological intervention itself to be more than an art is that there are evidence-based principles of psychological change that have sufficient scope as to reveal the functional similarities that exist amid these unique situations.

In the era of syndrome-based protocols, the uniqueness of human beings was hidden behind the assumption of latent diseases that drove pathology. The inertness of that approach is revealed in the harsh light of the COVID-19 crisis. It is not possible to step up to the broad set of psychological challenges presented by this moment in human history merely by syndromal labeling.

In this paper we have argued that a new form of functional analysis is available, now, that can be used to organize research on the behavioral features of this crisis in a way that builds on our existing knowledge of processes of change and that adds to that knowledge base. What is unique tests the scope of our principles and processes, and interventions that are shown to work because processes of change passed this test, increase confidence in the progressivity of our science. We need to do more as a field than to ask, "what will work?" Even if answers are found to such narrowly cast technological questions, these answers may apply to events that will rarely appear again. Instead, we need to ask, "based on our process knowledge, what will work and why?" That broader and more surely useful question is in essence a direct call for a more adequate form of functional analysis. By linking our analytic task to an extended evolutional meta-model, and by populating that model with evidence-based processes of change, we as a field are ready to rise to the challenge of novelty with a new form of functional analysis.

Declaration of competing interest

Dr. Hayes receives compensation for his work as a content expert from New Harbinger Publications. He also receives royalties and payments for his editorial work from various publishers.

Dr. Hofmann receives financial support from the Alexander von Humboldt Foundation (as part of the Humboldt Prize), NIH/NCCIH (R01AT007257), NIH/NIMH (R01MH099021, U01MH108168), and the James S. McDonnell Foundation 21st Century Science Initiative in Understanding Human Cognition – Special Initiative. He receives compensation for his work as editor from SpringerNature and the Association for Psychological Science, and as an advisor from the Palo Alto Health Sciences and for his work as a Subject Matter Expert from John Wiley & Sons, Inc. And SilverCloud Health, Inc. He also receives royalties and payments for his editorial work from various publishers.

Cory Stanton has nothing to declare.

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