Peer Reviewed

High-Reliability Organizing, Time, and Motion

Daved van Stralen, MD, FAAP; Sean D. McKay, Element Rescue, LLC; Thomas A. Mercer, RAdm, USN (Retired)

“Prothesis in phonetics refers to adding a syllable or sound to the beginning of a word. In psychophysics and experimental psychology, a prothetic process is the linear addition of a quantity to a continuum at the physiological level. Time considered as linear measurements will become confounded by nonlinearity (1).”

Introduction

How we perceive time influences our study of time. We may perceive time as continuity or a series of instances. Most likely, we perceive time as a quantitative continuum that we add to – how much time? We discriminate quantitative measures by additive or “prothetic” processes. Time as a quantitative continuum is a “prothetic process.” Prothesis in phonetics refers to adding a syllable or sound to the beginning of a word. In psychophysics and experimental psychology, a prothetic process is the linear addition of a quantity to a continuum at the physiological level. Time considered as linear measurements will become confounded by nonlinearity (1).

Continua for type and position are “metathetic” processes, physiological ones that substitute additions rather than adding to existing measurements. These are qualitative measures as we are changing the quality of the process (1). Consideration of time as a prothetic, or additive, process means we discriminate categories based on our sensitivity to differences. Psychophysics describes this as “just noticeable differences” or JND (1).

“Time, a linear, prothetic process, is readily considered a line without a beginning or end. However, we can use other time models, such as a branching tree model where the past is fixed and linear, but the future is open.”

Time, a linear, prothetic process, is readily considered a line without a beginning or end. However, we can use other time models, such as a branching tree model where the past is fixed and linear, but the future is open. Time branches into multiple possible futures (2). These approaches find different uses, such as planning compared to engagement in a novel or uncertain situation.

The fundamental distinction in the realm of instant-based time models reflects contrasting perspectives on the nature of temporal progression. One pivotal categorization within this domain revolves around the dichotomy between linear and backward-linear models, each offering unique insights into time structure.

“Linear models present time as a straightforward progression, akin to a continuous line extending from the past through the present and to the future. This representation implies a singular, unidirectional flow, suggesting a coherence in the temporal narrative. Here, time unfolds in a seamless, unbroken sequence, with each instant following the one before it in an orderly fashion.”

Linear models present time as a straightforward progression, akin to a continuous line extending from the past through the present and to the future. This representation implies a singular, unidirectional flow, suggesting a coherence in the temporal narrative. Here, time unfolds in a seamless, unbroken sequence, with each instant following the one before it in an orderly fashion. The linear model encapsulates that the future is undetermined and open to unfolding events, making it a canvas for countless potentialities.

“Regardless of the chosen model, the concept of minimal and maximal elements in temporal ordering adds another layer of intricacy. In the temporal framework, minimal elements correspond to the idea of first instants in time, signifying the starting points or origins, while maximal elements represent the last instants, indicating conclusions or ultimate endpoints.”

In contrast, backward-linear models introduce a more nuanced and complex portrayal of time. These models propose a tree-like structure, acknowledging that the past is fixed and follows a linear trajectory while the future branches into multiple possibilities.

In this view, the past is immutable and serves as the foundation for the present moment, which acts as a crossroads leading to various potential futures. The branching nature of backward-linear models allows for considering the future's divergent paths, capturing the notion of an open future with multiple unfolding scenarios.

Regardless of the chosen model, the concept of minimal and maximal elements in temporal ordering adds another layer of intricacy. In the temporal framework, minimal elements correspond to the idea of first instants in time, signifying the starting points or origins, while maximal elements represent the last instants, indicating conclusions or ultimate endpoints. Whether a temporal model embraces or eschews these minimal and maximal elements contributes to the overall narrative of the nature of time.

Ultimately, these distinctions in instant-based time models prompt contemplation about the nature of temporal reality. Linear models simplify the temporal narrative into a continuous stream, highlighting the openness of the future, while backward-linear models acknowledge the fixed nature of the past and the branching possibilities that lie ahead. Considering minimal and maximal elements further enriches the discourse, prompting exploration into the origins and endpoints of time within each conceptual framework. As we delve into these distinctions, we deepen our understanding of time's intricate tapestry and the philosophical implications embedded in our conceptualizations of its structure.

"Considering minimal and maximal elements further enriches the discourse, prompting exploration into the origins and endpoints of time within each conceptual framework. As we delve into these distinctions, we deepen our understanding of time's intricate tapestry and the philosophical implications embedded in our conceptualizations of its structure."

This disregards the effect of time on thinking and actions. We use the lateral prefrontal cortex when we take purposive, unrehearsed, or unplanned actions. The longer we continue to act, the more we use the lateral prefrontal cortex. Other factors include complexity, novelty, uncertainty, or ambiguity of the information. Nevertheless, time is the stimulus that places thought and action into the lateral prefrontal cortex, the only part of the cortex that can coordinate actions. The lateral prefrontal cortex executes elaborate behavior, speech fluency, and creative activity (3).

Temporal logics and temporal-based actions support the sense of agency for the individual while also following a formal logic structure. This is reasoning and logic about agents, agency, and their actions of "*stit* logics," such as "The agent sees to it that …" This describes how an agent's choices bear on the world (2).

Time can affect truth propositions. We can more accurately describe the world using truth values that may change over time. These are "tensed propositions," which we distinguish from "tenseless propositions," those that never change. Tenseless propositions are always true or always false (4).

Our comprehension of the temporal progression, often construed as a sequence of distinct spatial positions occupied by an object, intricately ties our perception of time to the concept of motion, as elucidated by the philosopher Le Poidevin (2). This connection between time and motion becomes even more pronounced when examined through the lens of physics, where the use of reference frames plays a pivotal role in understanding the dynamic nature of events.

"In the realm of physics, a reference frame serves as a coordinate system that allows us to pinpoint the location of an object in space at various points in time. It acts as a conceptual scaffold that facilitates the measurement of motion and the establishment of a temporal order."

In the realm of physics, a reference frame serves as a coordinate system that allows us to pinpoint the location of an object in space at various points in time. It acts as a conceptual scaffold that facilitates the measurement of motion and the establishment of a temporal order. To illustrate, consider an individual inside a moving vehicle; their reference frame differs from those outside the vehicle. Despite the undeniable motion of the vehicle, each person, whether inside or outside, perceives themselves as stationary within their respective reference frames. This highlights the subjective nature of motion perception and underscores the importance of reference frames in shaping our understanding of temporal dynamics.

The dichotomy between stationary Eulerian specifications and moving Lagrangian specifications further contributes to our comprehension of different reference frames in physics. Eulerian specifications involve observations from fixed points in space, providing a static perspective on events. On the other hand, Lagrangian specifications involve observations within the flow of events, capturing the dynamic essence of motion. These specifications essentially represent distinct vantage points from which we can interpret and analyze the temporal unfolding of phenomena.

"The dichotomy between stationary Eulerian specifications and moving Lagrangian specifications further contributes to our comprehension of different reference frames in physics. Eulerian specifications involve observations from fixed points in space, providing a static perspective on events."

To delve deeper into these specifications is to unravel the intricacies of different reference frames. The stationary Eulerian observer witnesses events from a fixed standpoint, akin to an objective observer outside the flow of change. Conversely, the moving Lagrangian observer is immersed in the dynamic currents of events, experiencing phenomena unfolding from a perspective inextricably linked to the motion itself.

> ***"Understanding these specifications as different reference frames illuminates the relativity inherent in our perception of time and motion. It underscores that our understanding of temporal order is contingent on the vantage point from which we observe events."***

Understanding these specifications as different reference frames illuminates the relativity inherent in our perception of time and motion. It underscores that our understanding of temporal order is contingent on the vantage point from which we observe events. The dynamic interplay between different reference frames invites us to consider the subjective nature of our temporal experiences. It challenges us to reconcile these diverse perspectives in our quest to comprehend the intricate dance between time and motion in the tapestry of the universe.

A reference frame is a standard to measure motion and rest, allowing the description of motion without regard to forces and masses. An "inertial frame" describes the relative motions of bodies in the system. This is a spatial reference frame with some means of measuring time to distinguish uniform and accelerated motions.

Perhaps protocols for emergency use would have more utility if we studied them in the context of time, motion, and acceleration. This occurs whether our reference frame is one of Eulerian or Lagrangian specifications.

Fear-Circuit Behaviors

While the time for actions brings in the lateral prefrontal cortex, motion itself brings in the ventromedial prefrontal cortex (vmPFC) and the phylogenetically older midbrain periaqueductal gray (PAG) nucleus.

> ***"While the time for actions brings in the lateral prefrontal cortex, motion itself brings in the ventromedial prefrontal cortex (vmPFC) and the phylogenetically older midbrain periaqueductal gray (PAG) nucleus."***

A distant threat within the "flight distance," whether temporal or spatial, increases activity in the ventromedial prefrontal cortex (vmPFC), a region important for decision-making in uncertain, risky, ambiguous, or context-dependent conditions. The vmPFC uses conceptual information about specific outcomes to shape affective responses, such as determining the most adaptive response given the particular situation (5). The vmPFC connects to the amygdala to determine the motivational importance or degree of the threat (6). The amygdala connects onward to the bed nucleus of the stria terminalis (BNST) to control a repertoire of behavioral defensive states (7, 8).

Additional proximal threats will switch activity from the vmPFC to the phylogenetically older midbrain periaqueductal gray (PAG) nucleus. The PAG identifies an approaching or receding threat to functionally switch the repertoire of behaviors to fast reflexive behaviors (e.g., fight, flight, or freeze) (7, 9, 10). This continuous switching within the PAG is a blend of the bottom-up responses to threats before they come to our awareness and top-down cortical neuromodulation from the vmPFC and the anterior cingulate cortex.

The subjective representation of threat and the degree to which it is felt is processed in the midbrain periaqueductal gray (PAG) nucleus. The PAG coordinates behaviors essential to survival, including threat reflexes, rapid changes to subcortical behaviors, and startle/posture corrections. The PAG also processes the proximity of threats (8).

The PAG also identifies an approaching or receding threat (9) specific to one of the *greatest* fears, an approaching predator. Detection of changes in distance from threat functionally switches the repertoire of behaviors the animal uses (9). Berkun et al. (11) found this from the descriptions of army recruits in dangerous situations. Distance as perceived physical proximity or time dominated the thinking of "evacuators," becoming the determinant for running away.

> ***"This movement from contextual decision-making under uncertainty in the vmPFC to reflexive decision-making from the PAG makes the fight or flight of the fear reactions appear to be the same as the fight or flight from threat reflexes. What it describes, though, is actually the functional flow of response to a developing danger as apprehension leads to avoidance (flight), then becomes engagement (self-defensive fight)."***

This movement from contextual decision-making under uncertainty in the vmPFC to reflexive decision-making from the PAG makes the fight or flight of the *fear reactions* appear to be the same as the fight or flight from *threat reflexes*. What it describes, though, is actually the functional flow of response to a developing danger as apprehension leads to avoidance (flight), then becomes engagement (self-defensive fight). As a functional approach, *fear reactions* (PAG) develop from distance-based assessments, while *threat reflexes* (amygdala) come from active danger.

The PAG has different functions in its several dorsoventral and rostrocaudal divisions. Dorsal stimulation promotes passive freezing, while ventral stimulation promotes escape and other active coping behaviors (8). From nose to tail, active coping strategies shift from moderate threat display to active defense, aggressive defense, strong threat display, and *non-opioid*-mediated analgesia, followed by vigorous escape when the enemy is near. When escape from an enemy is impossible, passive coping strategies disengage from the environment, and behaviors shift to freezing, then moderate to strong immobility with increasing proximity. Lastly, strong freezing with *opioid*-mediated analgesia occurs (12, 13).

Social distance, a concept with multifaceted implications, operates as a dynamic force that can manifest as a threat or as a source of support within the intricate fabric of human interactions. The impact of social distance becomes particularly pronounced when considering its dual role in evoking a sense of threat or fostering a supportive environment.

> ***"Social distance, a concept with multifaceted implications, operates as a dynamic force that can manifest as a threat or as a source of support within the intricate fabric of human interactions. The impact of social distance becomes particularly pronounced when considering its dual role in evoking a sense of threat or fostering a supportive environment."***

In instances where social distance takes on the guise of a threat, its effects mirror those elicited by more palpable dangers. The close physical proximity of an individual perceived as threatening triggers a cascade of responses akin to those evoked by a conventional threat. This includes heightened vigilance, accelerated heart rates, and the release of stress hormones. The emotional and physiological reactions to perceived threats underscore the intricate link between our social dynamics and our innate survival instincts, emphasizing that social encounters can activate the same primal responses as encounters with physical danger.

Moreover, transmitting fear responses through social interactions adds another layer of complexity to the interplay between social distance and threat perception. The contagious nature of emotions within social settings underscores the powerful influence that interpersonal dynamics can exert on individual well-being. Fear, as an emotional contagion, can spread through social networks, amplifying the impact of perceived threats and contributing to a shared sense of unease within a community.

Conversely, social distance can manifest as a potent source of support in the face of stress. Human beings, social creatures by nature, have evolved mechanisms to create protective factors against the strains of life. Social support, characterized by meaningful connections and interpersonal bonds, is a buffer against stressors. This protective function is observable at the neurobiological level, as evidenced by the modulation of the hypothalamus–pituitary–adrenal (HPA) axis responsiveness to social stress.

In moments of social support, individuals experience a reduction in the activation of the HPA axis, leading to a dampening of stress-related physiological responses. This physiological modulation reflects the intricate interplay between social connections and the body's stress response system. The presence of a supportive social network serves as a form of psychological and physiological resilience, mitigating the impact of external stressors and fostering a more adaptive response to challenges.

> ***"In essence, the dual nature of social distance, acting both as a threat and a source of support, underscores the profound influence of social dynamics on human well-being. The delicate balance between the perception of proximity and the quality of social interactions significantly shapes our emotional and physiological responses."***

In essence, the dual nature of social distance, acting both as a threat and a source of support, underscores the profound influence of social dynamics on human well-being. The delicate balance between the perception of proximity and the quality of social interactions significantly shapes our emotional and physiological responses. Understanding this interplay is essential for navigating the complex landscape of social relationships and harnessing the potential of social support as a powerful ally in the face of life's challenges (14).

Fear reactions are conscious sensations experienced when exposed to an imminent threat (15, 16). The amygdala sends signals to the brain's unconscious (subcortical) and conscious (prefrontal cortex) regions, accounting for the uncontrolled fear responses and the feeling of fear. The emotional response of fear, preceded by a threat to self-preservation, is to diminish danger (17). This creates the drive to avoid or escape, generally focusing on self-interest, self-protection, or the protection of others. We can regulate the feelings of fear by reappraising the situation or suppressing the behaviors ((18-21) personal experience of the authors).

Anatomic Location

The initial fear reaction is cortical. With increasing proximity to the threat, fear migrates to the midbrain.

A distant threat within the "flight distance," whether temporal or spatial, increases activity in the ventromedial prefrontal cortex (vmPFC) - a region important for decision-making in uncertain, risky, ambiguous, or context-dependent conditions. The vmPFC uses conceptual information about specific outcomes to shape affective responses, such as determining the most adaptive response given the particular situation (5). The vmPFC connects to the amygdala to determine the motivational importance or degree of the threat (6). The amygdala connects onward to the bed nucleus of the stria terminalis (BNST) to control a repertoire of behavioral defensive states (7, 8).

Additional proximal threats will switch activity from the vmPFC to the phylogenetically older midbrain periaqueductal gray (PAG) nucleus. The PAG identifies an approaching or receding threat to functionally switch the repertoire of behaviors to fast reflexive behaviors (e.g., fight, flight, or freeze) (7, 9, 10). This continuous switching within the PAG is a blend of the bottom-up responses to threats before they come to our awareness and top-down cortical neuromodulation from the vmPFC and the anterior cingulate cortex.

When the threat becomes proximal, we observe increased PAG activity. This forebrain-to-midbrain switch is anatomically credible in light of descending connections between the vmPFC/amygdala and PAG.

> ***"he implications of social interactions, particularly the close physical proximity of an individual perceived as threatening, evoke responses analogous to those elicited by more overt forms of danger. The VIP connects to the amygdala and then to the PAG for defensive and aggressive behaviors."***

Intimidation through proximity.

Intimidation through proximity unveils a psychological and physiological interplay that underscores the profound impact of social distance on human behavior. Social distance, a crucial determinant of personal boundaries, serves the dual purpose of maintaining a secure "flight distance" and engendering a sense of control over one's immediate environment. The implications of social interactions, particularly the close physical proximity of an individual perceived as threatening, evoke responses analogous to those elicited by more overt forms of danger. The VIP connects to the amygdala and then to the PAG for defensive and aggressive behaviors.

The concept of a safe "flight distance" is deeply ingrained in our evolutionary heritage, reflecting an instinctual need for personal space and a buffer zone to assess and respond to potential threats. In this context, social distance acts as a crucial mechanism to establish and maintain a sense of safety. The violation of this perceived safe distance can trigger a cascade of reactions similar to overt threats, including heightened alertness, increased heart rate, and the release of stress hormones. The intimate link between social proximity and threat perception highlights how our social environment influences our fundamental survival instincts.

Moreover, the subjective nature of favorable or unfavorable social distance is acknowledged, emphasizing the unique lens through which individuals perceive and navigate their interpersonal space. However, the peripersonal space, proximal to the body, introduces an objective dimension to this subjective experience. This measurable space constitutes an intimate zone where intrusion by others induces discomfort and triggers specific neural responses.

The ventral intraparietal area (VIP) and a polysensory zone in the precentral gyrus are key neural substrates that encode and process information related to peripersonal space. These areas form part of the intricate neural network responsible for integrating sensory inputs and motor responses in the context of spatial awareness. Within these neural structures, visual receptive fields play a pivotal role in delineating and mapping the boundaries of peripersonal space. The responses exhibited by these areas are finely tuned to the presence of nearby or approaching objects, reflecting a heightened sensitivity to potential threats within this intimate zone surrounding the body.

In essence, intimidation through proximity underscores the significance of social distance as a regulator of perceived threat and personal comfort. The intricate neural mechanisms associated with peripersonal space highlight the physiological underpinnings of these experiences, shedding light on how our brains navigate the complex interplay between social interactions, physical proximity, and the fundamental need for personal safety. As we delve into the nuances of intimidation through proximity, we gain a deeper understanding of the intricate dance between our evolutionary instincts and the intricacies of the social landscape. (10, 22).

> ***"Changes due to time can surpass our capabilities to process new or changing information. This is as true for large organizations operating within a financial market as it is for an individual contemplating the changing appearance of a neonate."***

Conclusion

Our perception of time as quantitative and linear, a series of "time instants," confounds our ability to plan for and work with the qualitative changes in time during evolving nonlinear time series. Perception implies neurologic processing; we must process the salience and relevance of time to give it meaning *during* events. The truth value of some propositions can change with time, while others do not. Classical logic and deductive reasoning are static thought processes not capable of guiding reasoning for abrupt changes or the engagement of forcing functions. We have temporal and multiple other logics (23).

Perception also occurs within our brain – diverse places for our diverse senses. Time, itself, has a putative location in the hippocampus but is itself not a sense. However, it alters our other senses as we interpret events regarding our safety. Changes due to time can surpass our capabilities to process new or changing information. This is as true for large organizations operating within a financial market as it is for an individual contemplating the changing appearance of a neonate.

Time may shift our perceptions of the ventromedial prefrontal cortex (vmPFC) for decision-making in uncertain, risky, ambiguous, or context-dependent conditions. Alternatively, time may drive our perceptions deeper into the brain, the phylogenetically older midbrain periaqueductal gray (PAG) nucleus. Our perceptions drive a repertoire of escape and fast reflexive behaviors (e.g., fight, flight, or freeze).

Finally, time is a measure of movement in the hippocampus. Seemingly irrelevant items abruptly become relevant, even dangerous. For this, the PAG nucleus supports escape and protective behaviors.

What is not accounted for in this discussion is acceleration. Acceleration is more deadly as it confounds our ability to predict trajectories, hence the future, and our capability to withstand the momentum of the threat.

References:

1. Stevens SS. On the Psychophysical Law. Psychological Review 1957;64(3):153-81.

2. Goranko V, Rumberg A. Temporal Logic. In: Zalta EN, Nodelman U, editors. The Stanford Encyclopedia of Philosophy. Fall 2023 ed. on line: Metaphysics Research Lab, Stanford University; 2023.

3. Fuster J. The Prefrontal Cortex: Academic Press; 2015.

4. Emery N, Markosian N, Sullivan M. Time. In: Zalta EN, editor. The Stanford Encyclopedia of Philosophy. Winter 2020 Edition ed: Metaphysics Research Lab, Stanford University; 2020.

5. Roy M, Shohamy D, Wager. TD. Ventromedial prefrontal-subcortical systems and the generation of affective meaning. Trends in Cognitive Sciences. 2012;16(3):147-56.

6. Fellows LK, Farah MJ. The role of ventromedial prefrontal cortex in decision making: judgment under uncertainty or judgment per se? Cereb Cortex. 2007;17(11):2669-74. Epub 2007/01/30. doi: 10.1093/cercor/bhl176. PubMed PMID: 17259643.

7. Mobbs D, Headley DB, Ding W, Dayan P. Space, Time, and Fear: Survival Computations along Defensive Circuits. Trends Cogn Sci. 2020;24(3):228-41. Epub 2020/02/08. doi: 10.1016/j.tics.2019.12.016. PubMed PMID: 32029360.

8. Mobbs D, Petrovic P, Marchant JL, Hassabis D, Weiskopf N, Seymour B, et al. When fear is near: threat imminence elicits prefrontal-periaqueductal gray shifts in humans. Science. 2007;317(5841):1079-83. Epub 2007/08/25. doi: 10.1126/science.1144298. PubMed PMID: 17717184; PubMed Central PMCID: PMCPMC2648508.

9. Adolphs R. The biology of fear. Curr Biol. 2013;23(2):R79-93. Epub 2013/01/26. doi: 10.1016/j.cub.2012.11.055. PubMed PMID: 23347946; PubMed Central PMCID: PMCPMC3595162.

10. Graziano MS, Cooke DF. Parieto-frontal interactions, personal space, and defensive behavior. Neuropsychologia. 2006;44(6):845-59. Epub 2005/11/10. doi: 10.1016/j.neuropsychologia.2005.09.009. PubMed PMID: 16277998.

11. Berkun MM, Bialek HM, Kern RP, Yag K. Experimental Studies of Psychological Stress in Man. Psychological Monographs: General and Applied. 1962;76(15):1-39

12. Koutsikou S, Apps R, Lumb BM. Top down control of spinal sensorimotor circuits essential for survival. The Journal of Physiology. 2017;595(13):4151-8.

13. Watson TC, Koutsikou S, Cerminara NL, Flavell CR, Crook J, Lumb BM, et al. The olivo-cerebellar system and its relationship to survival circuits. Frontiers in Neural Circuits. 2013;7.

14. Brill-Maoz N, Maroun M. Extinction of fear is facilitated by social presence: Synergism with prefrontal oxytocin. Psychoneuroendocrinology. 2016;66:75-81. Epub 2016/01/23. doi: 10.1016/j.psyneuen.2016.01.003. PubMed PMID: 26799850.

15. Panksepp J, Fuchs T, Iacobucci P. The basic neuroscience of emotional experiences in mammals: The case of subcortical FEAR circuitry and implications for clinical anxiety. Applied Animal Behaviour Science. 2011;129(1):1-17.

16. LeDoux JE, Pine DS. Using Neuroscience to Help Understand Fear and Anxiety: A Two-System Framework. Am J Psychiatry. 2016;173(11):1083-93. Epub 2016/11/02. doi: 10.1176/appi.ajp.2016.16030353. PubMed PMID: 27609244.

17. Oatley K, Johnson-Laird PN. Cognitive approaches to emotions. Trends Cogn Sci. 2014;18(3):134-40. Epub 2014/01/07. doi: 10.1016/j.tics.2013.12.004. PubMed PMID: 24389368.

18. Ochsner KN, Gross JJ. Cognitive emotion regulation: Insights from social cognitive and affective neuroscience. Current directions in psychological science. 2008;17(2):153-8.

19. Heilman RM, Crişan LG, Houser D, Miclea M, Miu AC. Emotion regulation and decision making under risk and uncertainty. Emotion Review. 2010;10(2):257-65.

20. Cutuli D. Cognitive reappraisal and expressive suppression strategies role in the emotion regulation: an overview on their modulatory effects and neural correlates. Frontiers in systems neuroscience. 2014;8:175.

21. Gross JJ. Emotion regulation: Conceptual and empirical foundations. In: Gross JJ, editor. Handbook of emotion regulation. New York, NY: The Guilford Press; 2014. p. New York, N.

22. Lloyd DM. The space between us: A neurophilosophical framework for the investigation of human interpersonal space. Neuroscience & Biobehavioral Reviews 2009;33(3):297-304.

23. van Stralen D, McKay SD, Mercer TA. Operational Logics and Inference During [1/f or f -1] Noise Events: High-Reliability Operations (HRO). Neonatology Today. 2022;17(3):18-31.

Disclosure: The authors have no disclosures.

NT

Corresponding Author

Daved van Stralen, MD, FAAP
Associate Professor, Pediatrics
Department of Pediatrics
Loma Linda University School of Medicine
11175 Campus Street
CP-A1121
Loma Linda, CA 92350
Email: DVanStra@llu.edu

Thomas A. Mercer
Rear Admiral
United States Navy (Retired)

Sean McKay
Executive Partner / Director, Disruptive Rescue & Austere Medicine
Element Rescue - Response Solutions within Nonlinear Complex Environments
Greenville, South Carolina, United States

Acknowledgments

Karl Weick, Rensis Likert Distinguished University Professor of Organizational Behavior and Psychology, Emeritus, University of Michigan

William J. Corr, formerly with the Los Angeles City Fire Department

H. Stefan Bracha, University of University of Hawai‘i at Mānoa, United States Department of Veterans Affairs

Adrian Wolfberg, Ph.D., Senior Program Officer at the National Academy of Sciences National Academy of Sciences

Errol van Stralen, Ancora Corporate Training