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Building a transdisciplinary expert consensus on the cognitive drivers of performance under pressure: An international multi-panel Delphi study

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Introduction: The ability to perform optimally under pressure is critical across many occupations, including the military, first responders, and competitive sport. Despite recognition that such performance depends on a range of cognitive factors, how common these factors are across performance domains remains unclear. The current study sought to integrate existing knowledge in the performance field in the form of a transdisciplinary expert consensus on the cognitive mechanisms that underlie performance under pressure.

Methods: International experts were recruited from four performance domains [(i) Defense; (ii) Competitive Sport; (iii) Civilian High-stakes; and (iv) Performance Neuroscience]. Experts rated constructs from the Research Domain Criteria (RDoC) framework (and several expert-suggested constructs) across successive rounds, until all constructs reached consensus for inclusion or were eliminated. Finally, included constructs were ranked for their relative importance.

Results: Sixty-eight experts completed the first Delphi round, with 94% of experts retained by the end of the Delphi process. The following 10 constructs reached consensus across all four panels (in order of overall ranking): (1) Attention; (2) Cognitive Control—Performance Monitoring; (3) Arousal and Regulatory Systems—Arousal; (4) Cognitive Control—Goal Selection, Updating, Representation, and Maintenance; (5) Cognitive Control—Response Selection and Inhibition/Suppression; (6) Working memory—Flexible Updating; (7) Working memory—Active Maintenance; (8) Perception and Understanding of Self—Self-knowledge; (9) Working memory—Interference Control, and (10) Expert-suggested—Shifting.

Discussion: Our results identify a set of transdisciplinary neuroscience-informed constructs, validated through expert consensus. This expert consensus is critical to standardizing cognitive assessment and informing mechanism-targeted interventions in the broader field of human performance optimization.

KEYWORDS

high performance, cognition, expert consensus, assessment, transdisciplinary

Background

A range of cognitive factors are considered key to attaining and sustaining optimal performance under pressure across application domains, such as the military, first responders, and competitive sport (Grier, 2012; Williams and Jackson, 2019; Aidman, 2020; Crameri et al., 2021). The terms used to define this field have remained relatively broad, such as High Performance Cognition introduced as an overarching construct for studies of human performance and skill acquisition (Cowley et al., 2020) covering a full range of conditions and skill levels, from novices to experts. As such they have not focused on the high-pressure[1] element inherent across most performance domains. As the cognitive factors that underlie performance under pressure are distinct from those required within low-pressure contexts (e.g., Eysenck and Wilson, 2016), we extend the definition of high performance cognition to emphasize such high-pressure cognitive factors. That is, we will use a narrower definition of high performance cognition as cognitive factors that underpin performance under pressure. As an example of a candidate high performance cognitive factor, the ability to ignore task-irrelevant stimuli (distractors) is a key to staying focused on the task at hand under high-pressure conditions, which are known to challenge attentional processes (e.g., Janelle, 2002; Eysenck and Wilson, 2016; Martins, 2016). Despite high performance cognition being relevant across performance domains, to date, research in this space has progressed largely in domain-specific siloes. As such, it is not known how common these cognitive factors are across performance domains, nor can this question be answered easily given that domains tend to define and study these cognitive factors differently.

The emerging field of high performance cognition is in need of a coherent, unified framework to integrate existing knowledge and guide future research and progress (Cowley et al., 2020). There are a number of key benefits to having a unified framework high performance cognition. First, a unified framework can significantly enhance the efficiency of research progress through the field being able to benefit from learnings made across different domains (including avoiding repetition of mistakes; Fiore and Salas, 2008). Second, through the integration of knowledge across domains, a unified framework can enable a more comprehensive understanding of cognition in optimal performance *via* access to a wider range of operational contexts and populations. Critically, a limited context or scope of application can mask the influence of key moderators, resulting in misinterpretations (Burwitz et al., 1994). Third, a unified framework across performance domains will facilitate access to a wider range of resources and technologies to strengthen the field's capacity to measure and optimize performance under pressure (e.g., see Williams et al., 2008 for a review). Finally, through integrating approaches and methods from different disciplines, a unified framework can facilitate new discoveries that are transformative, enabling significant leaps in thinking and new applications that transcend domain-specific boundaries (Fiore et al., 2008).

A barrier to establishing a unified framework of high performance cognition is the domain-specific nature of terminology and methods. Domain-specific terminology and methods make it difficult to integrate knowledge across domains, largely owing to the inability to compare findings that have been obtained through different methods. For instance, in sport, there has been extensive focus and progress achieved through domain-specific cognitive paradigms, such as those that gauge "anticipation," i.e., the ability to predict what an opponent will do next (Williams and Jackson, 2019). Similarly, in the military, response inhibition and threat detection are commonly assessed in combat scenarios (e.g., the shoot/do not shoot paradigm; Biggs et al., 2021), while in aviation, situation awareness is typically measured using the domain-specific Situation Awareness Global Assessment Technique (Endsley, 2017). While domain-specific paradigms have strengths (e.g., Davids et al., 2015), the insights that they offer cannot be easily integrated across performance domains because the performance factors they assess confound the influence of domain-specific context (and experience within that context) with domain-general individual differences in high performance cognitive factors. To enable integration across different domains, the performance field is in need of a cognitive framework that uses comparable methods that are not confounded by domain-specific context or experience.

A framework that has the capacity to unify the current knowledge base through systematizing terminology and methods across performance domains is the Research Domain Criteria (RDoC; Insel et al., 2010). The RDoC emerged a framework to shift psychiatric research away from diagnostic and categorical understanding of psychiatric disorders and toward a more neuroscience-informed approach that conceptualizes psychopathology as reflecting dimensional, transdiagnostic neurobehavioral constructs. Supporting this shift toward transdiagnostic approaches, different diagnostic groups have been shown to share neurobiological underpinnings that correspond with functional dimensions independently of diagnostic label (for a review, see Cuthbert, 2022) In essence, diagnostic systems fundamentally misrepresent the mechanisms that drive psychopathology. In turn, research that studies diagnostic groups in a silo can produce misleading findings (owing to restricted range) as well as will hold back efforts to integrate knowledge across diagnoses to produce a more representative and accurate mechanistic understanding of psychopathology (Morris et al., 2022).

Arguably, the lessons from a transdiagnostic approach to the mechanisms that drive risk for psychopathology can be applied to develop a better understanding of the drivers of high performance. Just like a transdiagnostic approach can offer a more representative mechanistic understanding of psychopathology risk, a transdisciplinary approach can offer a more representative mechanistic understanding of high performance, i.e., one that does

1 Generally, the term 'high pressure' is intended to cover a range of conditions, such as threat, ambiguity, change, and performance expectations, that characterize operational contexts across performance domains (Bartone et al., 1998; Nieuwenhuys and Oudejans, 2017).

not confound domain-specific experience nor is limited by domain-specific bounds. Critically, understanding the neurocognitive mechanisms that drive high performance independently of domain will not only inform the detection of high performance potential in individuals but also guide the development of mechanism-targeted interventions to optimize performance across diverse operational settings (Fogarty et al., in press).

In addition to offering systematic terminology and measures to facilitate the integration of knowledge across different performance domains, the suitability of the RDoC as a framework for high performance cognition is highlighted by research showing that its constructs and measures are indeed relevant to high performance. Specifically, the RDoC lists 48 constructs and subconstructs that are grouped into six higher-order domains: Negative Valence Systems, Positive Valence Systems, Cognitive Systems, Systems for Social Processes, Arousal/Regulatory Systems, and Sensorimotor Systems (See Table 1 for more details). Whereas these constructs have to date been applied to understanding the mechanisms of risk and psychopathology, their dimensional range encompasses normal functioning and thereby may be implicated as driving potential for high performance in healthy individuals. Indeed, a number of RDoC constructs have already been linked to high performance. For instance, high performance has been linked to *Cognitive Control—Response Inhibition/Suppression* has been linked to high performance in sport (Vestberg et al., 2012; Chen et al., 2019) and military domains (Biggs and Pettijohn, 2022). Likewise, *Working Memory* and *Attention* have been linked to high performance in sport (Voss et al., 2010; Vestberg et al., 2017) and aviation (Causse et al., 2011; Gray et al., 2016). While research using RDoC-listed measures is

TABLE 1 RDOC constructs (see foot note 2).

Negative valence domain	Positive valence domain	Cognitive systems domain	Systems for social processes domain	Arousal/regulatory systems domain	Sensorimotor systems domain
Acute threat	Reward Responsiveness (*Reward Anticipation*; *Initial Response to Reward*; *Reward Satiation*)	Attention	Affiliation & Attachment	Arousal	Motor actions (*Action Planning & Selection*; *Sensorimotor Dynamics*; *Initiation*; *Execution*; *Inhibition & Termination*)
Potential threat	Reward Learning (*Probabilistic & Reinforcement Learning*; *Reward Prediction Error*; *Habit*)	Perception (*Visual Perception*; *Auditory Perception*; *Olfactory/ Somatosensory/ Multimodal Perception*)	Social Communication (*Reception of Facial Communication*; *Production of Facial Communication*; *Reception of Non-Facial Communication*; *Production of Non-Facial Communication*)	Circadian Rhythms	Agency and ownership
Sustained threat	Reward valuation (*Reward-Probability*; *Delay*; *Effort*)	Declarative memory	Perception & Understanding of self (*Agency*; *Self-Knowledge*)	Sleep and wakefulness	Habit
Loss		Language	Perception & Understanding of others (*Animacy Perception*; *Action Perception*; *Understanding Mental States*)		Innate motor patterns
Frustrative nonreward		Cognitive control (*Goal Selection, Updating, Representation, and Maintenance*; *Response Selection, Inhibition/ Suppression*; *Performance Monitoring*) Working memory (*Active Maintenance*; *Flexible Updating*; *Limited Capacity*; *Interference Control*)			

relatively scarce compared to research using cognitive tasks that are not recommended by the RDoC (e.g., Kalén et al., 2021) or domain-specific paradigms such as those described previously, such research nonetheless highlights the relevance of the RDoC to high performance. In summary, the RDoC offers a system through which to study a wide range of cognitive processes that underlie variance in human functioning. It offers specific definitions of cognitive factors coupled with extensively-validated, neuroscience-informed measures that are not confounded by domain-specific context or experience, and which have been linked to high performance across different performance domains. These qualities make the RDoC an ideal system to bring together current knowledge from different performance domains and toward an integrated, unified framework of high performance cognition.

The current study used an RDoC-guided Delphi process to translate the diversity of expert knowledge across performance domains into a neuroscience-informed expert consensus. Specifically, the current Delphi sought to establish consensus across performance domains on the key cognitive factors that drive optimal performance in high-pressure operational contexts. The Delphi technique is a data-driven approach that implements rigorous and robust procedures to reach consensus among experts (Brown, 1968). Transdisciplinary consensus is necessary for building an integrated framework of high performance cognition to guide more coherent, far-reaching future progress across the performance field. A unified framework of high performance cognition supported by neuroscience evidence and uniformly-defined transdisciplinary constructs will also facilitate a broad agreement on the measurement tools for cognitive assessment as well as stimulating the development of neurocognitive mechanism-targeted interventions for performance optimization across diverse operational settings.

Materials and methods

The current study employed RDoC-guided Delphi surveys to establish an expert consensus (Brown, 1968), on the key drivers of optimal performance under pressure. The Delphi method involves multiple iterations of an anonymous opinion survey, with each iteration incorporating participant feedback from the previous round. This process is repeated until a pre-determined level of consensus is reached (detailed below). Specifically, the current Delphi was an international, transdisciplinary, multi-panel Delphi study, with four panels representing experts from one of four performance domains: Military occupations (*Defense domain*); Sport and competition (*Competitive Sport domain*); First responder and other safety-critical, civilian high-stakes roles (*Civilian High-stakes domain*); and academics in areas directly relevant to understanding cognitive-affective processes that drive optimal performance under stress in dynamic, complex environments (*Performance Neuroscience*). Thus, there were three applied domain panels and one academic domain panel.

A pre-Delphi stage preceded the main Delphi data collection. The pre-Delphi stage included forming a Delphi Advisory group ($n=8$) to guide our Delphi processes to ensure suitability of content and scope across all four domains. This study, including Advisory group participation in the pre-Delphi processes, was approved by the Monash University Ethics Committee and registered with Defence Science and Technology Group's Low Risk Ethics Panel (DSTG LREP). All participants consented to participate. Pre-Delphi and Delphi sequence of events are summarized in Figure 1.

Participants

Experts were identified through searches of key publications and organization websites as well as through suggestions made by experts. We aimed to recruit both practitioner and academic experts (as suggested by Baker et al., 2006). Criteria for inclusion as an expert practitioner included (a) having national or international recognition (e.g., coach for a national sport team) or (b) being suggested by at least two experts. Criteria for inclusion as an academic expert included (a) having at least three first- or senior-author peer-reviewed publications relevant to study *or* (b) being practitioner-researchers with at least one key publication *and* suggested by at least two experts. The list of experts was screened by the Advisory group members, who then made recommendations according to priority (based on study aims). We invited up to 20 experts per panel, which allowed for non-acceptance of invite and up to 50% drop-out without resulting in less than the required minimum of 10 per panel (Okoli and Pawlowski, 2004).

Invited experts who expressed interest in taking part were sent further information about the study by email, given a link to provide consent, and invited to attend an online Webinar-style information session led by the research team (which was recorded and made available for those who could not attend). This onboarding session described the background and rationale for the study, Delphi methodology, and an overview of the survey processes and instructions for completing the surveys. The recording was again sent to all participants prior to completing the first survey.

Constructs

In addition to the 48 published RDoC constructs and subconstructs,[2] additional constructs were suggested by expert participants, either during the Pre-Delphi phase (by Advisory group) or in Survey 1. An expert-suggested construct was included for consideration only if it met the following pre-determined criteria: (1) it was not a higher-order construct; (2) it was not adequately covered by existing RDoC constructs; and (3) there was evidence supporting an association between individual variations in performance on measures reflecting that construct and optimal performance under pressure. Constructs

2 https://www.nimh.nih.gov/research/research-funded-by-nimh/rdoc/constructs/

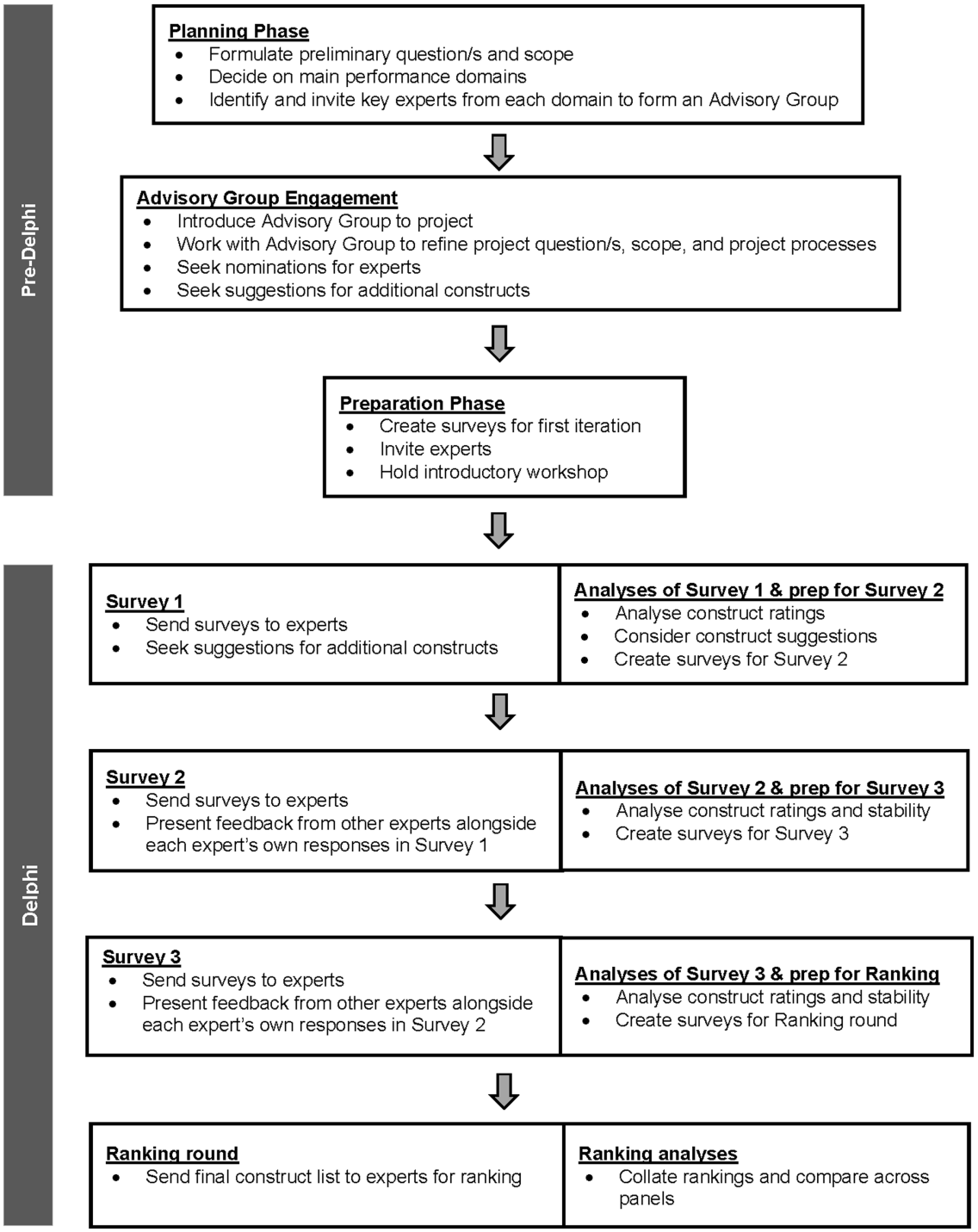

FIGURE 1
A visual representation of pre-Delphi and Delphi processes.

that failed to meet the above criteria were excluded from further consideration (See Figure S1; Supplementary materials). As the decision to include an expert-suggested construct depended on consideration of current research (to confirm it met the above criteria), when the team needed extra time to make a decision, the suggested construct was included for rating so as to not delay the survey schedule and excluded later.

Procedure

Delphi surveys were distributed *via* personalized links and completed using Qualtrics and data analyses were conducted using SPSS ver. 27.

The key question presented to the experts throughout the Delphi surveys was: "How important do you think (RDoC/

expert-suggested construct, e.g., attention) is to *optimal performance* in *dynamic* and *high-pressure* environments?" This question and corresponding *key term* definitions/features were decided through discussion with the Advisory group experts. The decision to use expert-guided definitions instead of using pre-existing definitions depended on the latter differed across domains. As the Advisory group included experts across the relevant domains, seeking their input to create Advisory-guided definitions enabled us to capture the defining features of key terms that applied across domains. These key terms and definitions were provided to all experts in the instructions as well as were accessible across the survey for all rounds. Specifically, *optimal performance* was defined according to three key features: (a) Implies sustained/consistent performance on multiple occasions under varying conditions; (b) May cover preparation, execution, and recovery phases; and (c) Applies to any level of technical expertise—from novices to experts. Further, when completing the Delphi surveys, experts were asked to imagine some typical scenarios that they considered representative of optimal performance in their field and to keep these in mind as they answered the questions (and using these same scenarios across survey iterations). *Dynamic environments* were defined according to two key features: (a) Have capacity to change; and (b) Are not static, consistent, or overly predictable. Finally, *high-pressure environments* were defined according to three key features: (a) Often involve high risk or capacity for significant loss or gain. In some contexts, this could be a life-or-death situation (could also be described as "high visibility," "high expectation," and "high demand"); (b) May include varying levels of complexity (involving uncertainty and ambiguity); and (c) May have multiple aspects requiring attention, tracking, decisions, and other cognitive manipulations. Ratings were given on a six-point Likert scale, which included the following response options: (1) Extremely important; (2) Very important; (3) Moderately important; (4) Slightly important; (5) Not important; and (6) Do not know/Unsure. The Delphi survey content (presented to experts in the first round) is included in the Supplementary materials.

We followed Delphi best practice guidelines for defining consensus and analyzing expert ratings and criteria (Trevelyan and Robinson, 2015). Specifically, consensus was determined as equal to or greater than 80% of experts voting a construct as important (i.e., extremely or very important; Putnam et al., 1995). Once a construct reached this level of consensus, it was removed from subsequent surveys and entered into the final construct list for that panel. Constructs rated as moderately, slightly, or *not* important by equal to or greater than 60% of experts were excluded from further consideration, as were any constructs whose rankings remained stable across rounds (assessed using Wilcoxon matched-pairs signed ranks tests; De Vet et al., 2005). Participants who responded "Do not know/Unsure" were not included in the stability analyses (for that construct). While there is very little research to inform the most suitable Likert scale response options to use in a Delphi (Drumm et al., 2022), we included a "Do not know/Unsure" option to avoid spurious changes in opinion over time.

Constructs not meeting these criteria were re-entered into the next survey round. This process was repeated until there were no constructs remaining, with all constructs having either reached consensus or been excluded Constructs were considered within panels, except for the constructs that were suggested at Round 1, which were entered into Round 2 across panels regardless of the panel that suggested them.

Final ranking

At the conclusion of the survey rounds, experts were asked to rank the constructs that reached panel consensus against each other in their relative importance to optimal performance under pressure. This exercise created a priority list of constructs to guide an initial integrated framework of performance cognition.

Results

Sixty-eight experts consented and completed the first Delphi round (Defense, $n = 20$; Competitive Sport, $n = 18$; Civilian High-Stakes, $n = 16$; and Performance Neuroscience, $n = 14$), and 64 experts stayed the whole 9-month long course of the study (retention rate = 94%). Thirty-four percent of experts were women. Experts' primary affiliations spanned across 11 countries. Overall, the most common country of primary affiliation was Australia (44%), followed by the United States (28%) and the United Kingdom (10%). Table 2 presents gender, affiliation country, and retention rates by performance panel.

TABLE 2 Characteristics across the panels.

	Performance neuroscience	Defence	Civilian high-stakes	Competitive sport
Gender (Women, %)	36%	45%	19%	33%
Countries	Australia (57%), United States (21%), Germany*, Lebanon*, and Netherlands*	Australia (35%), United States (55%), and United Kingdom (10%)	Australia (44%), Canada (12.5%), Netherlands*, Norway*, United Kingdom (13%), and United States (19%)	Australia (44%), United Kingdom (17%), United States (11%), Belgium*, Canada*, Germany*, Ireland*, and Italy*
Retention	100%	95%	81%	100%

*denotes <10%.

Table 3 presents the panels' ratings for all constructs at each survey round. Three rounds of surveys were required to reach the completion of the consensus process. The following 10 constructs reached consensus across all four panels (in order of overall ranking): (1) Attention; (2) Cognitive Control—Performance Monitoring; (3) Arousal and Regulatory Systems—Arousal; (4) Cognitive Control—Goal Selection, Updating, Representation, and Maintenance; (5) Cognitive Control—Response Selection and Inhibition/Suppression; (6) Working memory—Flexible Updating; (7) Working memory—Active Maintenance; (8) Perception and Understanding of Self—Self-knowledge; (9) Working memory—Interference Control, and (10) Expert-suggested—Shifting. Figure 2 presents the mean overall rankings of these 10 constructs. Table 4 presents all constructs that reached consensus, and their rankings per panel.

Three constructs reached consensus across all three applied domains, including (1) Processing Speed (expert suggested) and (2) Visual Perception (from Cognitive Systems), and Perception and Understanding of Others—Understanding Mental States (from Systems for Social Processes). The Defense panel uniquely rated Language and Declarative Memory (from Cognitive Systems) as important. The Civilian High-Stakes panel uniquely rated Auditory Perception (from Cognitive Systems) as important. The Competitive sport panel uniquely rated the greatest number of constructs (i.e., 7), with their top-ranking unique construct being Motor Actions—Execution (from Sensorimotor Systems).

Discussion

The aim of this study was to achieve a neuroscience-guided expert-based consensus on the cognitive constructs that are a key to optimal performance under pressure across multiple performance domains. This consensus is an important first step toward building the foundations for an integrated transdisciplinary framework of high performance cognition to guide coherence of future research and progress across the performance field. A transdisciplinary expert consensus was reached for 10 such constructs, as judged by academic and practice experts within all four Delphi panels. Seven of these transdisciplinary constructs were from the RDoC Cognitive Systems domain, with Attention being the top-voted transdisciplinary construct. Other RDoC constructs came from the Systems for Social Processes domain (i.e., self-knowledge) and the Arousal/Regulatory Systems domain (i.e., arousal). Shifting (of attentional or task set) was the only non-RDoC construct that reached transdisciplinary consensus.

The finding that attention ranked most important across domains is in line with the extensive focus dedicated to attention within each performance domain as well as its interaction with high-pressure contexts. For instance, in sport, there is a prominence of attentional models to explain performance under pressure (Nideffer, 1987; Eysenck and Wilson, 2016; Moran, 2016), such as the Attentional Control Theory: Sport (ACTS; Eysenck and Wilson, 2016), which was developed specifically to explain how attentional processes can be influenced by the high-pressure conditions that are inherent in sport, as well as other performance contexts. Attention is also a key process in situational awareness (Endsley, 1988), one of the most widely investigated cognitive constructs in aviation. Finally, attention is one of the most extensively studied outcomes in military cognitive enhancement research (Kelley et al., 2019). Critically, the fact that attention has been approached from such different perspectives across different domains highlights the potential of an integrated framework to enable such progress to be translated into a common language and applied to benefit other domains. For instance, an integrated, neuroscience-based framework could be applied to translating the ACTS model into a common language, thereby enabling its application across performance domains.

A finding that warrants special mention is that of self-knowledge being considered a key cognitive factor for optimal performance under pressure across all domains. While self-knowledge's relevance to optimal performance under pressure may be assumed *via* its contribution to higher-order concepts such as emotion regulation (e.g., Barrett et al., 2001), it has very rarely been examined (in the performance field) using cognitive or otherwise objective methods. In fact, there are no studies in the performance field that have used the RDoC-listed paradigm for this construct (i.e., self-referential memory paradigm). The fact that experts across all performance domains agreed that self-knowledge is a key to optimal performance combined with the lack of neurocognitive research in this space presents an outstanding opportunity for future research to create new knowledge on and/or solutions harnessing self-knowledge that could change the landscape of the performance field.

As explained in the introduction, an advantage of using the RDoC to guide an expert consensus on key constructs of high performance cognition is the extensive neuroscientific evidence upon which it is based, including a range of validated measures to index level of functioning on corresponding constructs. For instance, RDoC suggests response inhibition can be measured *via* the Stop-Signal Task (among other select measures). Unfortunately, the majority of current measures listed by the RDoC for corresponding constructs have only been validated in relation to risk of, and/or current psychopathology. It is yet to be determined whether many of the RDoC-listed measures will be sensitive to individual differences among high-performing individuals at the upper end of the normative distribution (according to similarly rigorous measurement standards). This is a crucial next step in building a high performance cognition framework that will systematize cognitive assessment methods.

Another key step moving forward is to delineate the scope and content of certain RDoC constructs as they relate to high performance cognition, such as attention. Whereas attention can be considered a more basic process than, say, situational awareness, it is itself unlikely to be sufficiently precise to guide meaningful mechanistic insights. Indeed, the RDoC notes different attentional processes that fall within the attention construct, including selective and divided attention. Further, the

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TABLE 3 All constructs, respective votes at each round, and outcomes.

Constructs		Performance domain	1	2	3
RDoC DOMAIN: Negative Valence					
Acute threat (Fear)		Perf. Neuroscience	64.3	71.4 ~	-
		Defence	45.0	63.2 ~	-
		Civilian High-stakes	43.8	78.6	56.3 ~
		Comp. Sport	44.4	72.2 ~	-
Potential threat (Anxiety)		Perf. Neuroscience	64.3	57.1 ~	-
		Defence	65.0	73.7 ~	-
		Civilian High-stakes	62.5	71.4 ~	-
		Comp. Sport	50.0	72.2 ~	-
Sustained threat		Perf. Neuroscience	50.0	50.0 ~	-
		Defence	35.0 #	-	-
		Civilian High-stakes	37.5 #	-	-
		Comp. Sport	72.2	66.7 ~	-
Loss		Perf. Neuroscience	35.7 #	-	-
		Defence	25.0 #	-	-
		Civilian High-stakes	12.5 #	-	-
		Comp. Sport	44.4	38.9 #	-
Frustrative nonreward		Perf. Neuroscience	21.4 #	-	-
		Defence	15.0 #	-	-
		Civilian High-stakes	25.0 #	-	-
		Comp. Sport	27.8 #	-	-
RDoC DOMAIN: Positive Valence					
Reward responsiveness	*Reward Anticipation*	Perf. Neuroscience	71.4	71.5 ~	-
		Defence	30.0 #	-	-
		Civilian High-stakes	18.8 #	-	-
		Comp. Sport	33.3 #	-	-
	Initial Response to Reward	Perf. Neuroscience	21.4 #	-	-
		Defence	5.0 #	-	-
		Civilian High-stakes	12.5 #	-	-
		Comp. Sport	11.1 #	-	-
	Reward Satiation	Perf. Neuroscience	35.7	35.7 #	-
		Defence	5.0 #	-	-
		Civilian High-stakes	12.5 #	-	-
		Comp. Sport	22.2 #	-	-
Reward learning	*Probabilistic & Reinforcement Learning*	Perf. Neuroscience	64.3	50.0 ~	-
		Defence	30.0 #	-	-
		Civilian High-stakes	37.5	50.0 ~	-
		Comp. Sport	38.9	50.0 ~	-
	Reward Prediction Error	Perf. Neuroscience	64.3	64.3 ~	-
		Defence	5.0 #	-	-
		Civilian High-stakes	25.0	14.3 #	-
		Comp. Sport	16.7 #	-	-
	Habit	Perf. Neuroscience	57.1	57.1 ~	-
		Defence	45.0	42.1 ~	-
		Civilian High-stakes	62.5	78.6 ~	-
		Comp. Sport	72.2	**83.3**	-
Reward valuation	*Reward (Probability)*	Perf. Neuroscience	50.0	35.7 ~	-
		Defence	25.0 #	-	-
		Civilian High-stakes	31.3	28.5 #	-
		Comp. Sport	22.2 #	-	-

(Continued)

TABLE 3 (Continued)

Constructs		Performance domain	1	2	3
	Delay	Perf. Neuroscience	21.4	21.4 #	-
		Defence	5.0 #	-	-
		Civilian High-stakes	18.8 #	-	-
		Comp. Sport	22.2	22.2 #	-
	Effort	Perf. Neuroscience	64.3	78.5 ~	-
		Defence	45.0	57.9 ~	-
		Civilian High-stakes	68.8	78.6 ~	-
		Comp. Sport	66.7	**94.4**	-
RDoC DOMAIN: Cognitive Systems					
Attention		**Perf. Neuroscience**	**100.0**	-	-
		Defence	**100.0**	-	-
		Civilian High-stakes	**93.8**	-	-
		Comp. Sport	**100.0**	-	-
Perception	*Visual Perception*	Perf. Neuroscience	64.3	42.9 ~	-
		Defence	**90**	-	-
		Civilian High-stakes	**93.8**	-	-
		Comp. Sport	**100**	-	-
	Auditory Perception	Perf. Neuroscience	64.3	42.9	35.7 #
		Defence	60.0	68.5 ~	-
		Civilian High-stakes	**81.3**	-	-
		Comp. Sport	66.7	55.6	33.3 #
	Olfactory/Somatosensory/Multimodal	Perf. Neuroscience	42.9	35.7 #	-
	Perception	Defence	35.0	21.1 #	-
		Civilian High-stakes	37.5 #	-	-
		Comp. Sport	38.9	27.8 #	-
Declarative memory		Perf. Neuroscience	71.4	71.4 ~	-
		Defence	75.0	**84.2**	-
		Civilian High-stakes	68.8	71.4 ~	-
		Comp. Sport	72.2	66.7 ~	-
Language		Perf. Neuroscience	71.4	64.3 ~	-
		Defence	75.0	**89.5**	-
		Civilian High-stakes	68.8	78.6 ~	-
		Comp. Sport	38.9	38.9 ~	-
Cognitive control	*Goal Selection*; *Updating,*	**Perf. Neuroscience**	**100.0**	-	-
	Representation, & Maintenance	**Defence**	**95.0**	-	-
		Civilian High-stakes	**87.5**	-	-
		Comp. Sport	**83.3**	-	-
	Response Selection; *Inhibition/*	**Perf. Neuroscience**	**92.9**	-	-
	Suppression	**Defence**	**95.0**	-	-
		Civilian High-stakes	**87.5**	-	-
		Comp. Sport	**83.3**	-	-
	Performance Monitoring	**Perf. Neuroscience**	*	**92.9**	-
		Defence	*	**94.7**	-
		Civilian High-stakes	*	**100.0**	-
		Comp. Sport	*	**94.4**	-
Working memory	*Active Maintenance*	**Perf. Neuroscience**	**85.7**	-	-
		Defence	75.0	**89.5**	-
		Civilian High-stakes	**81.3**	-	-
		Comp. Sport	77.8	**88.9**	-

(Continued)

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TABLE 3 (Continued)

Constructs		Performance domain	1	2	3
	Flexible updating	**Perf. Neuroscience**	**100.0**	-	-
		Defence	**95.0**	-	-
		Civilian High-stakes	**81.3**	-	-
		Comp. Sport	**88.9**	-	-
	Limited Capacity	Perf. Neuroscience	57.1	71.4 ~	-
		Defence	50.0	68.4 ~	-
		Civilian High-stakes	56.3	50.0 ~	-
		Comp. Sport	33.3	72.2 ~	-
	Interference Control	**Perf. Neuroscience**	**92.9**	-	-
		Defence	**85.0**	-	-
		Civilian High-stakes	**81.3**	-	-
		Comp. Sport	**88.9**	-	-
RDoC DOMAIN: Systems for Social Processes					
Affiliation & attachment		Perf. Neuroscience	35.7 #	-	-
		Defence	70.0	78.9 ~	-
		Civilian High-stakes	43.8	50.0 ~	-
		Comp. Sport	33.3 #	-	-
Social Communication	*Reception of Facial Communication*	Perf. Neuroscience	57.1	64.3 ~	-
		Defence	40.0 #	-	-
		Civilian High-stakes	68.8	78.6 ~	-
		Comp. Sport	38.9	22.2 #	-
	Production of Facial Communication	Perf. Neuroscience	42.9	21.4 #	-
		Defence	35.0 #	-	-
		Civilian High-stakes	37.5 #	-	-
		Comp. Sport	11.1 #	-	-
	Reception of Non-Facial Communication	Perf. Neuroscience	42.9	35.7 #	-
		Defence	45.0	63.2 ~	-
		Civilian High-stakes	56.3	64.3 ~	-
		Comp. Sport	22.2 #	-	-
	Production of Non-Facial Communication	Perf. Neuroscience	28.6 #	-	-
		Defence	40.0 #	-	-
		Civilian High-stakes	31.3 #	-	-
		Comp. Sport	16.7 #	-	-
Perception & understanding of self	*Agency*	Perf. Neuroscience	64.3	71.4 ~	-
		Defence	55.0	73.7 ~	-
		Civilian High-stakes	43.8	64.3 ~	-
		Comp. Sport	77.8	66.7 ~	-
	Self-Knowledge	**Perf. Neuroscience**	**92.9**	-	-
		Defence	**85.0**	-	-
		Civilian High-stakes	68.8	**100.0**	-
		Comp. Sport	**88.9**	-	-
Perception & understanding of others	*Animacy Perception*	Perf. Neuroscience	42.9	50.0 ~	-
		Defence	35.0 #	-	-
		Civilian High-stakes	37.5	21.4 #	-
		Comp. Sport	38.9	22.2 #	-
	Action Perception	Perf. Neuroscience	71.4	78.6 ~	-
		Defence	55.0	78.9 ~	-
		Civilian High-stakes	56.3	78.6 ~	-
		Comp. Sport	77.8	**83.3**	-

(Continued)

TABLE 3 (Continued)

Constructs		Performance domain	1	2	3
	Understanding Mental States	Perf. Neuroscience	78.6	78.6	-
		Defence	65.0	**89.5**	-
		Civilian High-stakes	**87.5**	-	-
		Comp. Sport	72.2	**88.9**	-
RDoC DOMAIN: Arousal/Regulatory Systems					
Arousal		**Perf. Neuroscience**	**92.9**	-	-
		Defence	**80.0**	-	-
		Civilian High-stakes	75.0	**92.9**	-
		Comp. Sport	**83.3**	-	-
Circadian rhythms		Perf. Neuroscience	57.1	57.1 ~	-
		Defence	50.0	47.4 ~	-
		Civilian High-stakes	50.0	50.0 ~	-
		Comp. Sport	44.4	50.0 ~	-
Sleep and wakefulness		Perf. Neuroscience	71.4	50.0 ~	-
		Defence	70.0	73.7 ~	-
		Civilian High-stakes	62.5	64.3 ~	-
		Comp. Sport	66.7	61.1 ~	-
RDoC DOMAIN: Sensorimotor Systems					
Motor actions	*Action Planning & Selection*	**Perf. Neuroscience**	71.4	**85.7**	-
		Defence	65.0	73.7 ~	-
		Civilian High-stakes	56.3	78.6 ~	-
		Comp. Sport	**94.4**	-	-
	Sensorimotor Dynamics	Perf. Neuroscience	42.9	42.9 ~	-
		Defence	40.0	21.1 #	-
		Civilian High-stakes	37.5	14.3 #	-
		Comp. Sport	**83.3**	-	-
	Initiation	Perf. Neuroscience	57.1	50.0 ~	-
		Defence	30.0 #	-	-
		Civilian High-stakes	37.5	42.9 ~	-
		Comp. Sport	77.8	77.8 ~	-
	Execution	Perf. Neuroscience	64.3	64.3 ~	-
		Defence	50.0	52.6 ~	-
		Civilian High-stakes	62.5	78.6 ~	-
		Comp. Sport	**94.4**	-	-
	Inhibition & Termination	Perf. Neuroscience	64.3	78.6 ~	-
		Defence	55.0	63.2 ~	-
		Civilian High-stakes	50.0	64.3 ~	-
		Comp. Sport	61.1	72.2 ~	-
Agency and ownership		Perf. Neuroscience	42.9	50.0 ~	-
		Defence	35.0 #	-	-
		Civilian High-stakes	31.3 #	-	-
		Comp. Sport	77.8	61.1 ~	-
Habit		Perf. Neuroscience	42.9	42.9 ~	-
		Defence	50.0	52.6 ~	-
		Civilian High-stakes	56.3	71.4 ~	-
		Comp. Sport	**88.9**	-	-
Innate motor patterns		Perf. Neuroscience	7.1 #	-	-
		Defence	15.0 #	-	-
		Civilian High-stakes	31.3	35.7 #	-
		Comp. Sport	22.2	22.2 #	-

(Continued)

TABLE 3 (Continued)

Constructs	Performance domain	1	2	3
Expert-suggested constructs				
Processing speed	Perf. Neuroscience	71.4	78.6 ~	-
	Defence	**90.0**	-	-
	Civilian High-stakes	**87.5**	-	-
	Comp. Sport	**88.9**	-	-
Shifting	**Perf. Neuroscience**	78.6	**85.7**	-
	Defence	**95.0**	-	-
	Civilian High-stakes	75.0	**92.9**	-
	Comp. Sport	**83.3**	-	-
Interoception	Perf. Neuroscience	-	57.1	57.1 ~
	Defence	-	63.2	45.0 ~
	Civilian High-stakes	-	28.6	38.5 #
	Comp. Sport	-	72.2	**83.4**
Later excluded				
Discomfort tolerance	**Perf. Neuroscience**	**85.7**	-	-
	Defence	**100.0**	-	-
	Civilian High-stakes	**87.5**	-	-
	Comp. Sport	77.8	**88.9**	-
Mental fatigue	**Perf. Neuroscience**	-	**85.7**	-
	Defence	-	73.7	**80.0**
	Civilian High-stakes	-	**85.7**	-
	Comp. Sport	-	**88.9**	-
Cognitive motor interference	Perf. Neuroscience	-	42.9	35.7 #
	Defence	-	10.5 #	-
	Civilian High-stakes	-	28.6	18.8 #
	Comp. Sport	-	72.2	61.1 ~
Procedural memory	Perf. Neuroscience	-	64.3	78.6 ~
	Defence	-	57.9	65.0 ~
	Civilian High-stakes	-	50.0	62.6 ~
	Comp. Sport	-	66.7	61.1 ~

Bolded font indicates consensus was reached. "~" denotes stability was reached. "#" denotes exclusion based on low importance.

RDoC differentiates between *sustained attention*, which is allocated to goal maintenance (a sub-construct of cognitive control), and *vigilance,* which they keep under attention (albeit this is noted informally, within RDoC Proceedings). While vigilance, selective attention, and divided attention are recognized (informally) as distinct attention-related processes by the RDoC (NIMH, 2011), they have not yet been formally listed as attention sub-constructs. Given the primary role of attention in performance, the performance field is ideally placed to lead the way toward delineating separable neural circuits for different types of attention.

A third priority for future research is to understand how the constructs highlighted through this Delphi study combine and interact to produce important higher order constructs, such as situational awareness and adaptability. Whereas the current Delphi study focused on basic cognitive processes of performance under pressure (as opposed to higher-order constructs such as situational awareness), this was not intended to detract from the importance of higher-order constructs. In fact, a main rationale behind the need to better understand the key basic processes that drive performance under pressure is to enable a more precise future understanding of higher-order processes and their measurement. Similarly, understanding how these cognitive processes interact with high-pressure environments to support optimal performance is a key to informing interventions for optimization of cognitive resilience (Flood and Keegan, 2022). Understanding how specific cognitive processes interact with context and state factors will be critical for informing precise mechanism-targeted interventions. For instance, understanding and measuring situational awareness in a way that reflects the different contributions of specific/basic cognitive factors (e.g., attention, working memory) means that when assessed across different contexts (under time pressure, under threat, in sport, in aviation, etc.) or across different individuals, any differences (or lack of) in overall situational awareness can be understood more precisely. For instance, two individuals might show comparable

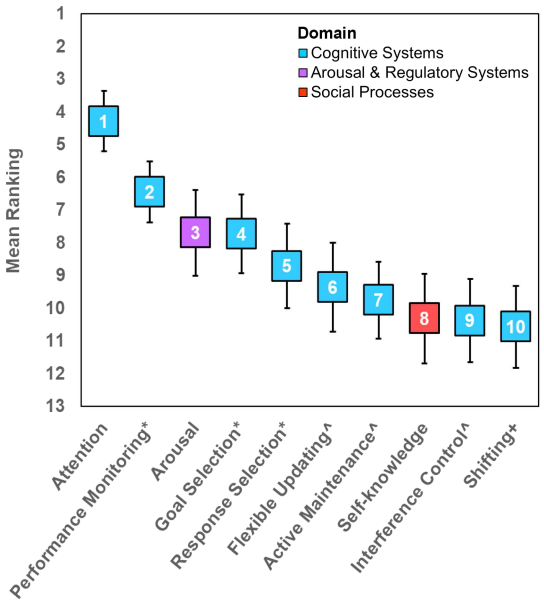

FIGURE 2
Mean ranking of the ten transdisciplinary constructs. Rank order is displayed within the corresponding marker. Error bars represent 95% Confidence Intervals. N.B. * denotes Cognitive Control subconstructs. ^ denotes Working Memory subconstructs. + denotes that Shifting was an expert-suggested construct (considered to belong in the Cognitive Systems Domain). 'Goal Selection' = Goal Selection; Updating; Representation; Maintenance. 'Response Selection' = Response Selection; Inhibition/Suppression.

TABLE 4 Construct rankings across panels.

Domain—Construct–*Subconstruct*	**Perf. neuroscience**	**Defence**	**Civilian high-stakes**	**Comp. sport**
CS—Attention	3	1	1	1
CS—Cognitive Control – *Performance Monitoring*	5	4	2	2
A/RS—Arousal	11	2	4	6
CS—Cognitive Control – *Goal Selection; Updating, Representation, & Maintenance*	1	6	5	7
CS—Cognitive Control – *Response Selection; Inhibition/Suppression*	2	5	6	14
CS—Working Memory – *Flexible Updating*	4	7	3	19
CS—Working Memory – *Active Maintenance*	8	12	9	11
SfSP—Perception and Understanding of Self - *Self-knowledge*	9	11	13	8
CS—Working Memory – *Interference Control*	6	13	8	15
ES—Shifting	10	8	11	13
ES—Processing Speed	–	3	7	10
CS—Perception – *Visual Perception*	–	9	10	4
SfSP—Perception and Understanding of Others – *Understanding Mental States*	–	10	12	16
SS—Motor Actions – *Action Planning and Selection*	7	–	–	5
CS—Language	–	14	–	–
CS—Declarative Memory	–	15	–	–
SS—Motor Actions – *Execution*	–	–	–	3
PVS—Reward Valuation – *Effort*	–	–	–	9
SfSP—Perception and Understanding of Others – *Action Perception*	–	–	–	12
ES—Interoception	–	–	–	17
SS—Motor Actions – *Sensorimotor Dynamics*	–	–	–	18
PVS—Reward Learning – *Habit*	–	–	–	20
SS—Habit	–	–	–	21
CS—Perception—*Auditory Perception*	–	–	14	-

overall situational awareness; however, the specific cognitive factors contributing to their overall situational awareness might differ considerably. Therefore, these individuals could respond very differently to training, depending on the focus of the training and the extent to which it matched their profile. In contrast, if their situational awareness abilities could be understood in terms of the combination of basic cognitive processes, then such knowledge could be used to develop personalized mechanism-targeted interventions such that precise cognitive processes can be selectively targeted. The same principle applies to situational awareness across different operational contexts. To this end, work is currently underway to create assessments of these cognitive interactions through integrated tasks wherein separate cognitive processes can be assessed in the context of other processes (controlled through task selection) while keeping their measurement separable (Wells et al., 2021; Kucina et al., 2022).

Limitations

There is a lack of generally agreed upon standards of Delphi best practices for analyzing expert ratings and defining consensus criteria, which can leave many key decisions at the discretion of the researchers leading it (Mitchell, 1991; Fink-Hafner et al., 2019). We addressed this uncertainty through detailed and transparent reporting as well as being guided by the available (albeit limited) research on what constitutes good practice in Delphi methodology (Okoli and Pawlowski, 2004; Hussler et al., 2011; Trevelyan and Robinson, 2015). Another potential limitation of the current Delphi is that levels of familiarity with the RDoC varied across expert subpanels. This was addressed early on and throughout the project through sending onboarding materials and holding workshops to explain the background and RDoC concepts, and recapping all the key points and definitions at each survey round. Finally, limitations pertaining to the representativeness of the current expert sample should be considered. For instance, our panel was dominated by experts from Australia, United States, and Europe. While we did send invitations to a number of experts from Asian countries (e.g., Singapore), this did not result in uptake. Future studies examining the opinions of experts from non-European countries will be important to confirm the current findings or highlight cultural differences in expert options. Another feature of the current study that might be considered to limit the representativeness of our findings is the selection of our panels. While the panels were chosen with the aim of ensuring maximal coverage of occupational groups and expertise pertaining to performance under pressure, the civilian high-stakes roles panel included a diverse range of occupations, from first responders to medical and aviation experts, potentially with insufficient numbers of experts within these sub-domains. However, as domains could continue to be broken down into smaller sub-domains, we believe that the conceptual grouping we used was more meaningful for our purposes than opting for more narrow occupational groups. Once an integrated framework gets developed, future research can examine similarities and differences across these sub-domains.

Despite the limitations inherent to the Delphi technique, its use in the current study is arguably one of its major strengths. First, as explained at the outset, the Delphi method is a rigorous data-driven approach that implements robust procedures to reach expert consensus. Second, the Delphi technique was uniquely suitable to achieve our aim to develop a trans-disciplinary consensus—as distinct from reviewing the evidence across the performance domains in search of the key constructs of high performance cognition. The latter would have been limited by the diversity of methods and terminology across the different domains. Rather, our aim was to transform the diversity and breadth of knowledge that exists across performance domains (which have been separated by domain silos) into a set of transdisciplinary, neuroscience-informed constructs based on expert agreement. An RDoC-guided Delphi method was perfectly suited to meet this goal. Indeed, this method has been used to create transformative frameworks in other fields faced with similar challenges (Yücel et al., 2019, 2021).

Conclusion

In conclusion, this Delphi study has produced a transdisciplinary expert consensus on the cognitive drivers of optimal performance under pressure across multiple performance domains. The resulting set of neuroscience-informed constructs, applicable within and across performance domains, can serve as an integrated framework of high performance cognition to facilitate shared progress in the broader field of human performance. An integrated framework of high performance cognition has potential to bolster a broad agreement on, and stimulate the development of (1) mechanism-sensitive measurement tools for precise cognitive assessment and (2) cognitive mechanism-targeted interventions to build cognitive fitness and optimize performance under high pressure. Finally, the current findings are of direct relevance to a broader understanding of optimal performance under pressure across operational environments as well as optimal functioning generally. That is, the ability to perform optimally under pressure of benefit to everyone, from an athlete competing in the Olympics to a parent dealing with a child's asthma attack. Through establishing the foundations for an integrated framework of high performance cognition, the current findings can facilitate future progress that transcends disciplinary bounds and inform systematic approaches to measuring and improving individuals' capacities to adapt to a wide range of challenges.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by Monash University Human Research Ethics Committee Defense Science Technology Group's Low Risk Ethics Panel (DSTG LREP). The patients/participants provided their written informed consent to participate in this study.

Author contributions

MY and EA conceived the study idea. LA and RK coordinated data collection and analyzed the data. LA wrote the first draft. All authors contributed to the Delphi and consensus processes, provided feedback on drafts, as well as read and approved the final manuscript.

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Conflict of interest

VM was employed by Mindflex Group Ltd. JG is a stockholder in MAP Biotech Pty Ltd. SC has received speakers fees Janssen-Cilag Australia, Lundbeck Otsuka Australia, Servier Australia; Investigator Initiated research funding Janssen-Cilag Australia; Lundbeck Otsuka Australia; Advisory Boards Lundbeck Otsuka Australia. AT has received research funding from BHP, Rio Tinto, and Shell. SD is a Member of the Board of Advisors Eisai Australia Pty Ltd. MY has received payments in relation to court-, expert witness-, and/or expert review-reports. JD was employed by Florida Maxima Corporation.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2022.1017675/full#supplementary-material

References

Aidman, E. (2020). Cognitive fitness framework: toward assessing, training and augmenting individual-difference factors underpinning high-performance cognition. *Front. Hum. Neurosci.* 13:466. doi: 10.3389/fnhum.2019.00466

Baker, J., Lovell, K., and Harris, N. (2006). How expert are the experts? An exploration of the concept of 'expert'within Delphi panel techniques. *Nurs. Res.* 14, 59–70. doi: 10.7748/nr2006.10.14.1.59.c6010

Barrett, L. F., Gross, J., Christensen, T. C., and Benvenuto, M. (2001). Knowing what you're feeling and knowing what to do about it: mapping the relation between emotion differentiation and emotion regulation. *Cognit. Emot.* 15, 713–724. doi: 10.1080/02699930143000239

Bartone, P. T., Adler, A. B., and Vaitkus, M. A. (1998). Dimensions of psychological stress in peacekeeping operations. *Mil. Med.* 163, 587–593. doi: 10.1093/milmed/163.9.587

Biggs, A. T., and Pettijohn, K. A. (2022). The role of inhibitory control in shoot/don't-shoot decisions. *Q. J. Exp. Psychol.* 75, 536–549. doi: 10.1177/17470218211041923

Biggs, A. T., Pistone, D., Riggenbach, M., Hamilton, J. A., and Blacker, K. J. (2021). How unintentional cues can bias threat assessments during shoot/don't-shoot simulations. *Appl. Ergon.* 95:103451. doi: 10.1016/j.apergo.2021.103451

Brown, B. B. (1968). Delphi process: A methodology used for the elicitation of opinions of experts. Rand Corp Santa Monica CA.

Burwitz, L., Moore, P. M., and Wilkinson, D. M. (1994). Future directions for performance-related sports science research: an interdisciplinary approach. *J. Sports Sci.* 12, 93–109. doi: 10.1080/02640419408732159

Causse, M., Dehais, F., and Pastor, J. (2011). Executive functions and pilot characteristics predict flight simulator performance in general aviation pilots. *Int. J. Aviat. Psychol.* 21, 217–234. doi: 10.1080/10508414.2011.582441

Chen, J., Li, Y., Zhang, G., Jin, X., Lu, Y., and Zhou, C. (2019). Enhanced inhibitory control during re-engagement processing in badminton athletes: an event-related potential study. *J. Sport Health Sci.* 8, 585–594. doi: 10.1016/j.jshs.2019.05.005

Cowley, B. U., Dehais, F., Fairclough, S., Karran, A. J., Palomäki, J., and Lappi, O. (2020). High performance cognition: information-processing in complex skills, expert performance, and flow. *Front. Psychol.* 11:579950. doi: 10.3389/fpsyg.2020.579950

Crameri, L., Hettiarachchi, I., and Hanoun, S. (2021). A review of individual operational cognitive readiness: theory development and future directions. *Hum. Factors* 63, 66–87. doi: 10.1177/0018720819868409

Cuthbert, B. N. (2022). Research domain criteria (RDoC): Progress and potential. *Curr. Dir. Psychol. Sci.* 31, 107–114. doi: 10.1177/09637214211051363

Davids, K., Araújo, D., Seifert, L., and Orth, D. (2015). *Expert Performance in Sport: An Ecological Dynamics Perspective. Routledge Handbook of Sport Expertise*. London: Routledge.

De Vet, E., Brug, J., De Nooijer, J., Dijkstra, A., and De Vries, N. K. (2005). Determinants of forward stage transitions: a Delphi study. *Health Educ. Res.* 20, 195–205. PMID: 15328302. doi: 10.1093/her/cyg111

Drumm, S., Bradley, C., and Moriarty, F. (2022). 'More of an art than a science'? The development, design and mechanics of the Delphi technique. *Res. Soc. Adm. Pharm.* 18, 2230–2236. doi: 10.1016/j.sapharm.2021.06.027

Endsley, M. R. (1988). Design and evaluation for situation awareness enhancement. Proceedings of the Human Factors Society annual meeting. Sage publications Sage CA: Los Angeles, 97–101.

Endsley, M. R. (2017). *Direct Measurement of Situation Awareness: Validity and Use of SAGAT. Situational Awareness*. London: Routledge.

Eysenck, M. W., and Wilson, M. R. (2016). Sporting performance, pressure and cognition: Introducing attentional control theory: Sport. In *An Introduction to Applied Cognitive Psychology.* (London: Psychology Press), 341–362.

Fink-Hafner, D., Dagen, T., Doušak, M., Novak, M., and Hafner-Fink, M. (2019). Delphi method: strengths and weaknesses. *Advances in Methodology and Statistics* 16, 1–19. doi: 10.51936/fcfm6982

Fiore, S. M., Hoffman, R. R., and Salas, E. (2008). Learning and performance across disciplines: an epilogue for moving multidisciplinary research toward an interdisciplinary science of expertise. *Mil. Psychol.* 20, S155–S170. doi: 10.1080/08995600701804939

Fiore, S. M., and Salas, E. (2008). Cognition, competition, and coordination: the "why" and the "how" of the relevance of the sports sciences to learning and performance in the military. *Mil. Psychol.* 20, S1–S9. doi: 10.1080/08995600701804764

Flood, A., and Keegan, R. J. (2022). Cognitive resilience to psychological stress in military personnel. *Front. Psychol.* 13:809003. doi: 10.3389/fpsyg.2022.809003

Fogarty, G. J., Crampton, J., Bond, J., Zaichkowsky, L. D., Taylor, P., and Aidman, E. (in press). "Neurobiological foundations of cognitive fitness in high-performance applications," in *The SAGE Handbook of Cognitive and Systems Neuroscience: Cognitive Systems, Development and Applications*. eds. G. J. Boyle, G. Northoff, F. Fregni, A. Pascual-Leone, M. Jahanshahi and B. Sahakian (SAGE Publishing).

Gray, R., Gaska, J., and Winterbottom, M. (2016). Relationship between sustained, orientated, divided, and selective attention and simulated aviation performance: training & pressure effects. *J. Appl. Res. Mem. Cogn.* 5, 34–42. doi: 10.1016/j.jarmac.2015.11.005

Grier, R. A. (2012). Military cognitive readiness at the operational and strategic levels: a theoretical model for measurement development. *J. Cogn. Eng. Decis. Mak.* 6, 358–392. doi: 10.1177/1555343412444606

Hussler, C., Muller, P., and Rondé, P. (2011). Is diversity in Delphi panelist groups useful? Evidence from a French forecasting exercise on the future of nuclear energy. *Technol. Forecast. Soc. Chang.* 78, 1642–1653. doi: 10.1016/j.techfore.2011.07.008

Insel, T., Cuthbert, B., Garvey, M., Heinssen, R., Pine, D. S., Quinn, K., et al. (2010). Research domain criteria (RDoC): toward a new classification framework for research on mental disorders. *Am. J. Psychiatr.* 167, 748–751. doi: 10.1176/appi.ajp.2010.09091379

Janelle, C. M. (2002). Anxiety, arousal and visual attention: a mechanistic account of performance variability. *J. Sports Sci.* 20, 237–251. doi: 10.1080/026404102317284790

Kalén, A., Bisagno, E., Musculus, L., Raab, M., Pérez-Ferreirós, A., Williams, A. M., et al. (2021). The role of domain-specific and domain-general cognitive functions and skills in sports performance: a meta-analysis. *Psychol. Bull.* 147, 1290–1308. doi: 10.1037/bul0000355

Kelley, A., Feltman, K. A., Nwala, E., Bernhardt, K., Hayes, A., Basso, J., et al. (2019). A systematic review of cognitive enhancement interventions for use in military operations.

Kucina, T., Wells, L., Lewis, I., De Salas, K., Kohl, A., Palmer, M., et al. (2022). A solution to the reliability paradox for decision-conflict tasks.

Martins, A. P. G. (2016). A review of important cognitive concepts in aviation. *Aviation* 20, 65–84. doi: 10.3846/16487788.2016.1196559

Mitchell, V. (1991). The Delphi technique: an exposition and application. *Tech. Anal. Strat. Manag.* 3, 333–358. doi: 10.1080/09537329108524065

Moran, A. P. (2016). *The Psychology of Concentration in Sport Performers: A Cognitive Analysis*. London: Psychology Press.

Morris, S. E., Sanislow, C. A., Pacheco, J., Vaidyanathan, U., Gordon, J. A., and Cuthbert, B. N. (2022). Revisiting the seven pillars of RDoC. *BMC Med.* 20:220. doi: 10.1186/s12916-022-02414-0

Nideffer, R. M. (1987). Issues in the use of psychological tests in applied settings. *The Sport Psychologist* 1, 18–28. doi: 10.1123/tsp.1.1.18

Nieuwenhuys, A., and Oudejans, R. R. D. (2017). Anxiety and performance: perceptual-motor behavior in high-pressure contexts. *Curr. Opin. Psychol.* 16, 28–33. doi: 10.1016/j.copsyc.2017.03.019

NIMH (2011). Cognitive systems: Workshop proceedings. Available at: https://www.nimh.nih.gov/research/research-funded-by-nimh/rdoc/cognitive-systems-workshop-proceedings

Okoli, C., and Pawlowski, S. D. (2004). The Delphi method as a research tool: an example, design considerations and applications. *Inf. Manag.* 42, 15–29. doi: 10.1016/j.im.2003.11.002

Putnam, J. W., Spiegel, A. N., and Bruininks, R. H. (1995). Future directions in education and inclusion of students with disabilities: a Delphi investigation. *Except. Child.* 61, 553–576. doi: 10.1177/001440299506100605

Trevelyan, E. G., and Robinson, N. (2015). Delphi methodology in health research: how to do it? *Eur. J. Integrat. Med.* 7, 423–428. doi: 10.1016/j.eujim.2015.07.002

Vestberg, T., Gustafson, R., Maurex, L., Ingvar, M., and Petrovic, P. (2012). Executive functions predict the success of top-soccer players. *PLoS One* 7:e34731. doi: 10.1371/journal.pone.0034731

Vestberg, T., Reinebo, G., Maurex, L., Ingvar, M., and Petrovic, P. (2017). Core executive functions are associated with success in young elite soccer players. *PLoS One* 12:e0170845. doi: 10.1371/journal.pone.0170845

Voss, M. W., Kramer, A. F., Basak, C., Prakash, R. S., and Roberts, B. (2010). Are expert athletes 'expert' in the cognitive laboratory? A meta-analytic review of cognition and sport expertise. *Appl. Cogn. Psychol.* 24, 812–826. doi: 10.1002/acp.1588

Wells, L., Kucina, T., Kohl, A., Lewis, I., De Salas, K., Aidman, E., et al. (2021). "A flexible gaming environment for reliably measuring cognitive control," in *Proceedings of the 2021 Human Factors and Medicine Research Symposium-Applying Neuroscience to Performance: From Rehabilitation to Human Cognitive Augmentation*.

Williams, A. M., Ericsson, K. A., Ward, P., and Eccles, D. W. (2008). Research on expertise in sport: implications for the military. *Mil. Psychol.* 20, S123–S145. doi: 10.1080/08995600701804863

Williams, A. M., and Jackson, R. C. (2019). Anticipation in sport: fifty years on, what have we learned and what research still needs to be undertaken? *Psychol. Sport Exerc.* 42, 16–24. doi: 10.1016/j.psychsport.2018.11.014

Yücel, M., Lee, R. S., and Fontenelle, L. F. (2021). A new consensus framework for phenotyping and treatment selecting in addiction and obsessive-compulsive–related disorders. *JAMA Psychiatry* 78, 699–700. doi: 10.1001/jamapsychiatry.2021.0243

Yücel, M., Oldenhof, E., Ahmed, S. H., Belin, D., Billieux, J., Bowden-Jones, H., et al. (2019). A transdiagnostic dimensional approach toward a neuropsychological assessment for addiction: an international Delphi consensus study. *Addiction* 114, 1095–1109. doi: 10.1111/add.14424

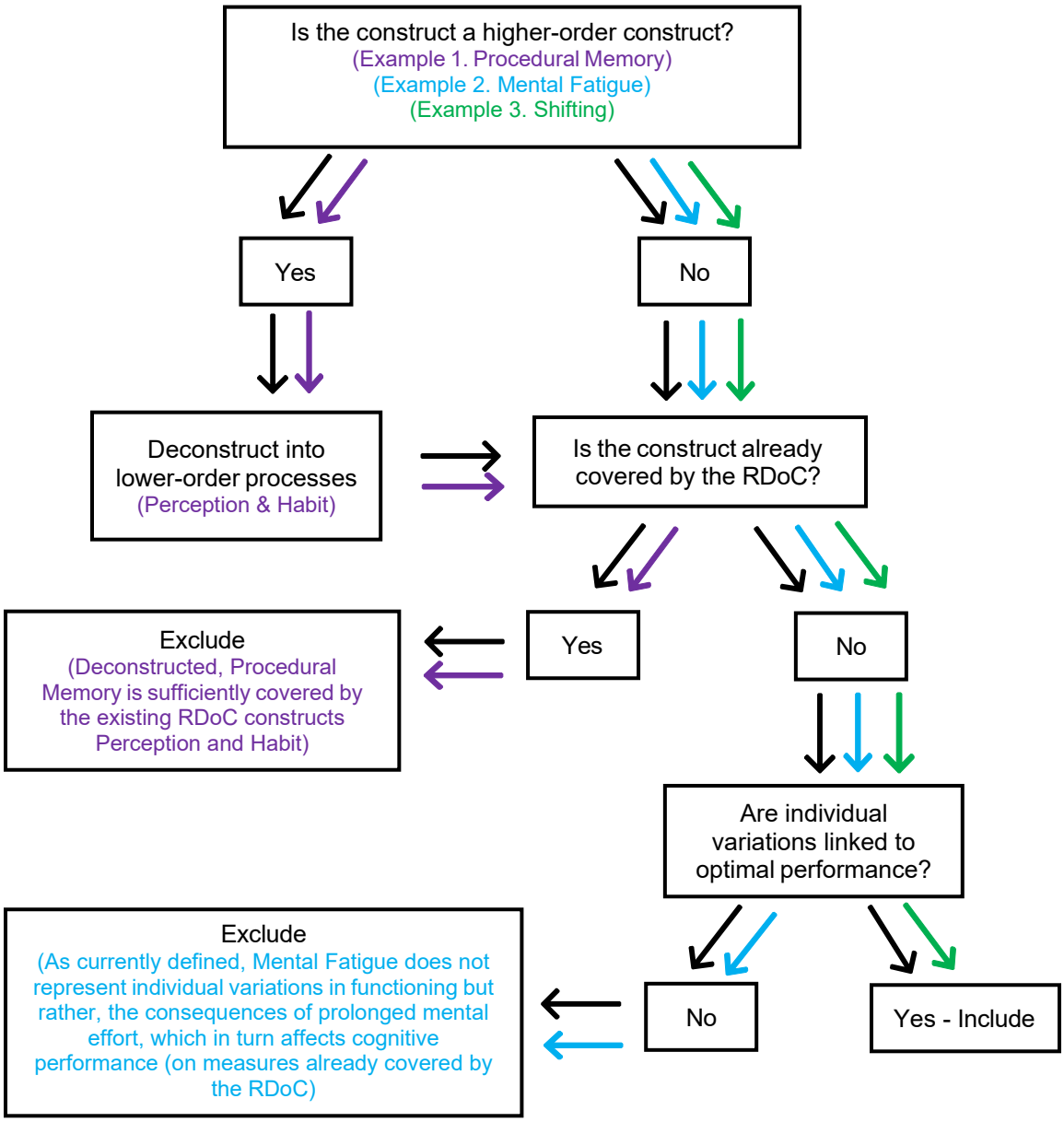

Figure S1. Decision making sequence for including expert-suggested constructs into the Delphi survey, including three examples of decisions made (represented by different colors).

Instructions

Name (Title, First, Last)

In what field do you work? (If transdisciplinary, detail the fields with the primary first)

With which category do you best align?

- ○ Defence
- ○ Sport and Competition
- ○ High-stakes roles (Including aviation, medical & first responder roles)
- ○ Applied Cognitive Neuroscience (Including cognitive and affective mechanisms)

INTRODUCTION

Optimal performance in dynamic and high-pressure environments is considered critical in many occupations such as competitive sport, first responder, law enforcement and military professions. While it is broadly acknowledged that performance in these contexts depends on multiple aspects of cognitive functioning (collectively comprising cognitive fitness), their exact nature and relative importance remain unclear. Our project aims to develop an expert consensus on the key dimensions of cognitive fitness, broadly applicable to diverse "performance under pressure" contexts. This consensus will inform a more systematic approach to extending the assessment of cognitive functioning from deficit to high performance, as well as to developing targeted interventions to modify cognitive performance through treatment, training and augmentation.

Our research question is "What are the psychological constructs that underlie optimal performance in dynamic and high-pressure environments?"

We will therefore be asking you "How important is [given construct] to optimal performance in dynamic and high-pressure environments?" from the perspective of **your expert field** for each RDoC construct and expert suggested constructs.

DEFINITIONS

Constructs (A measurable something that can be measured with multiple metrics. For this project, a "psychological construct" represents a specified dimension of behaviour that can be measured through a range of methods, i.e. self-report, response patterns, biomarkers etc.)
- Influence individual differences in real-time performance execution
- Are the most fundamental level of the construct (i.e. the building block, not a higher-order construct)
- Can or could be measured

Optimal Performance
- Implies sustained / consistent performance on multiple occasions under varying conditions
- Can cover preparation, execution, and recovery phases
- Applies to any level of technical expertise – from novices to experts

Dynamic environments
- Has the capacity to change
- Is not static, consistent, or overly predictable

High-pressure environments
- Often involves high risk or capacity for significant loss or gain. In some contexts, this could be a life or death situation (could also be described as 'high visibility', 'high expectation', 'high demand')
- May include varying levels of complexity (involving uncertainty, ambiguity)
- May have multiple aspects requiring attention, tracking, decisions, and other cognitive manipulations

Before we begin...

Before we begin...

We recognise that there are many scenarios that require optimal performance in your field and that each scenario might elicit different construct ratings.

We therefore ask you to imagine some typical scenarios that you would consider representative of optimal performance in your field. Have about three scenarios jotted down or ready in the forefront of your mind when you do the survey. They don't have to be exclusive or exclusionary of other scenarios, but they may help you whilst completing the survey.

Once you have a few scenarios where you think you can pinpoint optimal performance, please click the next arrow.

Instructions Part 2

INSTRUCTIONS

RDoC CONSTRUCTS

We ask you to rate the constructs listed in the RDoC according to their importance to optimal performance in dynamic and high-pressure environments, in your field.

For each construct, you can provide your rationale for rating as you have. This may be particularly important if you feel strongly about the rating you have provided. These comments will be shared anonymously with the Delphi panel in the subsequent round and have the potential to sway others' ratings on the construct. Since such comments will be shared widely amongst transdisciplinary experts, please try to keep your language communicable to educated lay persons.

Please answer all questions to the best of your ability, or simply reply "Don't know / Unsure" where you do not feel you have sufficient knowledge.

In subsequent rounds you will have the opportunity to revise your answers in light of the group's ratings and comments.

Please click on the construct name to be taken to the RDoC website for further enquiry. The description and behaviour provided by RDoC is included in the question if available.
At the start of each new RDoC domain page, you will be able to open a pdf to the definitions of the key terms in the question.

At the end of this questionnaire you will have the opportunity to offer additional psychological constructs to your original suggestions, provide additional comments and to review your ratings.

Importance: Negative Valence Systems

DOMAIN: Negative Valence Systems

Desciption: **Negative Valence Systems** are primarily responsible for responses to aversive situations or context, such as fear, anxiety, and loss.

Constructs:

- Acute Threat "Fear"
- Potential Threat "Anxiety"
- Sustained Threat
- Loss
- Frustrative Nonreward

Definitions of key terms.pdf

Comments from round 1 showed that people generally considered the relevance of the negative valence constructs in one of two ways:

1. The ability to perform optimally despite negative valence factors such as fear and anxiety
2. The effect of negative valence factors themselves on performance (either enhancing/optimising or disrupting/degrading it).

From now on, can we ask you to **concentrate on option 2**.

As an example for acute threat (‘fear’), consider two candidates going through Defence recruitment. As part of the selection process, they must complete a complex cognitive task in the presence of a threat cue.

Under neutral conditions (no threat cues) Candidate A performs the task to high standards. In the presence of a threat cue, the candidate demonstrates an **unusually strong fear response** and performs the task to **adequate standards**.

Candidate B also performs the task to high standards under neutral conditions (no threat cues). In the presence of a threat cue, they show a **normal fear response** and perform the cognitive task to the same **high standards**.

In these scenarios, one may say that acute threat ('fear') is relevant to optimal performance. Specifically, **all other things being equal**, Candidate A's elevated fear response interfered with their ability to perform the cognitive task to high standards.

When considering the relevance/importance of negative valence constructs, can we ask you to focus on their impact on performance while controlling for potential confounds (i.e., all other things being equal).

CONSTRUCT	Acute Threat "Fear"
Description (RDoC)	Activation of the brain's defensive motivational system to promote behaviours that protect the organism from perceived danger. Normal fear involves a pattern of adaptive responses to conditioned or unconditioned threat stimuli (exteroceptive or interoceptive). Fear can involve internal representations and cognitive processing, and can be modulated by a variety of factors.
Behaviour (RDoC)	Analgesia approach (early development), Avoidance, Facial expressions, Freezing, Open field, Response inhibition, Response time, Risk assessment, Social approach

How important do you think **Acute Threat "Fear"** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important
- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Acute Threat "Fear"** this way.

Please note that your comments here will be read by the research team and may be presented to all Delphi Panel members unless you select 'HIDDEN' in the following question (in which case only the research team will see the comments). For this reason, please ensure your comments are clear and use language that people outside of your field will understand. You will remain anonymous.

OPTIONAL: Please select 'HIDDEN' if you would like your above response to not be included in the anonymous pool of expert comments at the end of the iteration.

CONSTRUCT	Potential Threat "Anxiety"
Description (RDoC)	Activation of a brain system in which harm may potentially occur but is distant, ambiguous, or low/uncertain in probability, characterized by a pattern of responses such as enhanced risk assessment (vigilance). These responses to low imminence threats are qualitatively different than the high imminence threat behaviours that characterise fear.

How important do you think **Potential Threat "Anxiety"** is to optimal performance in dynamic and high-pressure environments?

- Extremely important
- Very important
- Moderately important
- Slightly important
- Not important / NA
- Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Potential Threat "Anxiety"** this way.

Please note that your comments here will be read by the research team and may be presented to all Delphi Panel members unless you select 'HIDDEN' in the following question (in which case only the research team will see the comments). For this reason, please ensure your comments are clear and use language that people outside of your field will understand. You will remain anonymous.

OPTIONAL: Please select 'HIDDEN' if you would like your above response to not be included in the anonymous pool of expert comments at the end of the iteration.

CONSTRUCT	Sustained Threat
Description (RDoC)	An aversive emotional state caused by prolonged (i.e., weeks to months) exposure to internal and/or external condition(s), state(s), or stimuli that are adaptive to escape or avoid. The exposure may be actual or anticipated; the changes in affect, cognition, physiology, and behaviour caused by sustained threat persist in the absence of the threat and can be differentiated from those changes evoked by acute threat.
Behaviour (RDoC)	Anhedonia/decreased appetitive behaviour, Anxious Arousal, Attentional bias to threat, Avoidance, Decreased libido, Helplessness behaviour, Increased conflict detection, Increased perseverative behaviour, Memory retrieval deficits, Punishment sensitivity

How important do you think **Sustained Threat** is to optimal performance in dynamic and high-pressure environments?

- Extremely important
- Very important
- Moderately important
- Slightly important
- Not important / NA
- Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Sustained Threat** this way.

Please note that your comments here will be read by the research team and may be presented to all Delphi Panel members unless you select 'HIDDEN' in the following question (in which case only the research team will see the comments). For this reason, please ensure your comments are clear and use language that people outside of your field will understand. You will remain anonymous.

OPTIONAL: Please select 'HIDDEN' if you would like your above response to not be included in the anonymous pool of expert comments at the end of the iteration.

CONSTRUCT	Loss
Description (RDoC)	A state of deprivation of a motivationally significant con-specific, object, or situation. Loss may be social or non-social and may include permanent or sustained loss of shelter, behavioural control, status, loved ones, or relationships. The response to loss may be episodic (e.g., grief) or sustained.
Behaviour (RDoC)	Amotivation, Anhedonia, Attentional bias to negative valenced information, Crying, Executive function, Guilt, Increased self-focus, Loss of drive, Loss-relevant recall bias, Morbid Thoughts, Psychomotor retardation, Rumination, Sadness, Shame, Withdrawal, Worry

How important do you think **Loss** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important
- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Loss** this way.

Please note that your comments here will be read by the research team and may be presented to all Delphi Panel members unless you select 'HIDDEN' in the following question (in which case only the research team will see the comments). For this reason, please ensure your comments are clear and use language that people outside of your field will understand. You will remain anonymous.

OPTIONAL: Please select 'HIDDEN' if you would like your above response to not be included in the anonymous pool of expert comments at the end of the iteration.

CONSTRUCT	Frustrative Nonreward
Description (RDoC)	Reactions elicited in response to withdrawal/prevention of reward, i.e., by the inability to obtain positive rewards following repeated or sustained efforts.
Behaviour (RDoC)	Physical and relational aggression

How important do you think **Frustrative Nonreward** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important
- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Frustrative Nonreward** this way.
Please note that your comments here will be read by the research team and may be presented to all Delphi Panel members unless you select 'HIDDEN' in the following question (in which case only the research team will see the comments). For this reason, please ensure your comments are clear and use language that people outside of your field will understand. You will remain anonymous.

OPTIONAL: Please select 'HIDDEN' if you would like your above response to not be included in the anonymous pool of expert comments at the end of the iteration.

Importance: Positive Valence Systems

DOMAIN: Positive Valence Systems

Description: **Positive Valence Systems** primarily responsible for responses to positive motivational situations or contexts, such as reward seeking, consummatory behavior, and reward/habit learning.

Constructs / Subconstructs

- Construct: Reward Responsiveness
  - Subconstruct: Reward Anticipation
  - Subconstruct: Initial Response to Reward
  - Subconstruct: Reward Satiation
- Construct: Reward Learning
  - Subconstruct: Probabilistic and Reinforcement Learning
  - Subconstruct: Reward Prediction Error
  - Subconstruct: Habit - PVS
- Construct: Reward Valuation
  - Subconstruct: Reward (probability)
  - Subconstruct: Delay
  - Subconstruct: Effort

Definitions of key terms.pdf

The following questions ask you to rate the Subconstructs under the Construct **Reward Responsiveness**

DOMAIN	Positive Valence Systems
CONSTRUCT	**Reward Responsiveness**
Description (RDoC)	Processes that govern an organism's hedonic response to impending or possible reward (as reflected in reward anticipation), the receipt of reward (as reflected in initial response to reward) and following repeated receipt of reward (as in reward satiation); across these subdomains, reward responsiveness primarily reflects neural activity to receipt of reward and reward cues and can also be measured in terms of subjective and behavioural responses.
Subconstructs	• Reward Anticipation • Initial Response to Reward • Reward Satiation

CONSTRUCT	Reward Responsiveness
SUB-CONSTRUCT	**Reward Anticipation**
Description (RDoC)	Processes associated with the ability to anticipate and/or represent a future incentive—as reflected in language expression, behavioural responses, and/or engagement of the neural systems to cues about a future positive reinforcer.

How important do you think **Reward Anticipation** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important
- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Reward Anticipation** this way.

Please note that your comments here will be read by the research team and may be presented to all Delphi Panel members unless you select 'HIDDEN' in the following question (in which case only the research team will see the comments). For this reason, please ensure your comments are clear and use language that people outside of your field will understand. You will remain anonymous.

OPTIONAL: Please select 'HIDDEN' if you would like your above response to not be included in the anonymous pool of expert comments at the end of the iteration.

CONSTRUCT	Reward Responsiveness
SUB-CONSTRUCT	**Initial Response to Reward**
Description (RDoC)	Processes evoked by the initial presentation of a positive reinforcer as reflected by indices of neuronal activity and verbal or behavioural responses.
Behaviour (RDoC)	Taste reactivity

How important do you think **Initial Response to Reward** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important
- ○ Moderately important

- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Initial Response to Reward** this way.

Please note that your comments here will be read by the research team and may be presented to all Delphi Panel members unless you select 'HIDDEN' in the following question (in which case only the research team will see the comments). For this reason, please ensure your comments are clear and use language that people outside of your field will understand. You will remain anonymous.

OPTIONAL: Please select 'HIDDEN' if you would like your above response to not be included in the anonymous pool of expert comments at the end of the iteration.

CONSTRUCT	Reward Responsiveness
SUB-CONSTRUCT	**Reward Satiation**
Description (RDoC)	Processes associated with the change in incentive value of a reinforcer over time as that reinforcer is consumed or experienced, as reflected in language expression, behavioural responses, and/or engagement of the neural systems.

How important do you think **Reward Satiation** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important
- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Reward Satiation** this way.

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comments). For this reason, please ensure your comments are clear and use language that people outside of your field will understand. You will remain anonymous.

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The following questions ask you to rate the Subconstructs under the Construct **Reward Learning**

DOMAIN	Positive Valence Systems
CONSTRUCT	**Reward Learning**
Description (RDoC)	A process by which organisms acquire information about stimuli, actions, and contexts that predict positive outcomes, and by which behaviour is modified when a novel reward occurs, or outcomes are better than expected. Reward learning is a type of reinforcement learning.
Subconstructs	• Probabilistic and Reinforcement Learning • Reward Prediction Error • Habit – PVS

CONSTRUCT	Reward Learning
SUB-CONSTRUCT	**Probabilistic and Reinforcement Learning**
Description (RDoC)	The ability to learn which actions or stimuli are associated with obtaining a reinforcer, even when a particular action or stimulus is not always associated with obtaining the reinforcer.

How important do you think **Probabilistic and Reinforcement Learning** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important
- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA

- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Probabilistic and Reinforcement Learning** this way.

Please note that your comments here will be read by the research team and may be presented to all Delphi Panel members unless you select 'HIDDEN' in the following question (in which case only the research team will see the comments). For this reason, please ensure your comments are clear and use language that people outside of your field will understand. You will remain anonymous.

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CONSTRUCT	Reward Learning
SUB-CONSTRUCT	**Reward Prediction Error**
Description (RDoC)	Processes associated with the difference between anticipated and obtained rewards are important for reinforcement learning. The error can indicate that the reward received was either larger than expected (positive prediction error) or smaller than expected (negative prediction error).
Behaviour (RDoC)	Goal tracking, Pavlovian approach, Reward-related speeding, Sign tracking

How important do you think **Reward Prediction Error** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important
- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Reward Prediction Error** this way.

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CONSTRUCT	Reward Learning
SUB-CONSTRUCT	**Habit**
Description (RDoC)	Sequential, repetitive, motor behaviours or cognitive processes elicited by external or internal triggers that, once initiated, can go to completion without continuous effortful oversight. Habits can be adaptive by virtue of freeing up cognitive resources. Habit formation is a frequent consequence of reward learning, but, over time, its expression can become resistant to changes in outcome value. Some habit-related behaviours could be pathological expressions of processes that under other circumstances subserve adaptive goals.
Behaviour (RDoC)	Compulsive behaviours, Repetitive behaviours, Stereotypic behaviours

How important do you think **Habit** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important
- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Habit** this way.

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The following questions ask you to rate the Subconstructs under the Construct **Reward Valuation**

DOMAIN	Positive Valence Systems
CONSTRUCT	**Reward Valuation**
Description (RDoC)	Processes by which the probability and benefits of a prospective outcome are computed by reference to external information, social context (e.g., group input), and/or prior experience. This computation is influenced by pre-existing biases, learning, memory, stimulus characteristics, and deprivation states. Reward valuation may involve the assignment of incentive salience to stimuli.
Subconstructs	• Reward (probability) • Delay • Effort

CONSTRUCT	Reward Valuation
SUB-CONSTRUCT	**Reward (probability)**
Description (RDoC)	Process by which the value of a reinforcer is computed as a function of its magnitude, valence, and predictability.

How important do you think **Reward (Probability)** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important
- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Reward (Probability)** this way.

Please note that your comments here will be read by the research team and may be presented to all Delphi Panel members unless you select 'HIDDEN' in the following question (in which case only the research team will see the comments). For this reason, please ensure your comments are clear and use language that people outside of your field will understand. You will remain anonymous.

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CONSTRUCT	Reward Valuation
SUB-CONSTRUCT	**Delay**
Description (RDoC)	Processes by which the value of a reinforcer is computed as a function of its magnitude and the time interval prior to its expected delivery.

How important do you think **Delay** is to optimal performance in dynamic and high-pressure environments?

- Extremely important
- Very important
- Moderately important
- Slightly important
- Not important / NA
- Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Delay** this way.

Please note that your comments here will be read by the research team and may be presented to all Delphi Panel members unless you select 'HIDDEN' in the following question (in which case only the research team will see the comments). For this reason, please ensure your comments are clear and use language that people outside of your field will understand. You will remain anonymous.

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CONSTRUCT	Reward Valuation
SUB-CONSTRUCT	**Effort**
Description (RDoC)	Processes by which the value of a reinforcer is computed as a function of its magnitude and the perceived costs of the physical or cognitive effort required to obtain it.

How important do you think **Effort** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important
- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Effort** this way.

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Importance: Cognitive Systems

DOMAIN: Cognitive Systems

Description: **Cognitive Systems** are responsible for various cognitive processes.

Constructs/Subconstructs

- Construct: Attention
- Construct: Perception
  - Subconstruct: Visual Perception
  - Subconstruct: Auditory Perception
  - Subconstruct: Olfactory/Somatosensory/Multimodal/Perception
- Construct: Declarative Memory
- Construct: Language
- Construct: Cognitive Control
  - Subconstruct: Goal Selection; Updating, Representation, and Maintenance
  - Subconstruct: Response Selection; Inhibition/Suppression
  - Subconstruct: Performance Monitoring
- Construct: Working Memory
  - Subconstruct: Active Maintenance
  - Subconstruct: Flexible Updating
  - Subconstruct: Limited Capacity
  - Subconstruct: Interference Control

Definitions of key terms.pdf

CONSTRUCT	Attention
Description (RDoC)	Attention refers to a range of processes that regulate access to capacity-limited systems, such as awareness, higher perceptual processes, and motor action. The concepts of capacity limitation and competition are inherent to the concepts of selective and divided attention.
Behaviour (RDoC)	ANT task distractibility, Attentional lapses vs sustained attention, Distractibility, Object/feature attention, Psychophysics, Spatial attention

How important do you think **Attention** is to optimal performance in dynamic and high-pressure environments?

○ Extremely important

- ○ Very important
- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Attention** this way.

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DOMAIN	Cognitive Systems
CONSTRUCT	**Perception**
Description (RDoC)	Perception refers to the process(es) that perform computations on sensory data to construct and transform representations of the external environment, acquire information from, and make predictions about, the external world, and guide action.
Subconstructs	• Visual Perception • Auditory Perception • Olfactory/Somatosensory/Multimodal/Perception

The following questions ask you to rate the Subconstructs under the Construct **Perception**

CONSTRUCT	Perception
SUB-CONSTRUCT	**Visual Perception**
Description (Delphi Team)	Refers to the process(es) that perform computations on sensory data to construct and transform representations of the external environment, acquire information from, and make predictions about, the external world, and guide action.
Behaviour (RDoC)	Discrimination, identification and localization, Perceptual learning, Perceptual priming, Reading, Stimulus detection, Visual acuity

How important do you think **Visual Perception** is to optimal performance in dynamic and high-pressure environments?

- ◯ Extremely important
- ◯ Very important
- ◯ Moderately important
- ◯ Slightly important
- ◯ Not important / NA
- ◯ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Visual Perception** this way.

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CONSTRUCT	Perception
SUB-CONSTRUCT	**Auditory Perception**
Description (Delphi Team)	Refers to the process(es) that perform computations on auditory data to construct and transform representations of the external environment, acquire information from, and make predictions about, the external world, and guide action.
Behaviour (RDoC)	Perceptual identification, Perceptual learning, Perceptual priming, Spatial localization, Stimulus detection

How important do you think **Auditory Perception** is to optimal performance in dynamic and high-pressure environments?

- ◯ Extremely important
- ◯ Very important

- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Auditory Perception** this way.

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CONSTRUCT	Perception
SUB-CONSTRUCT	**Olfactory/Somatosensory/Multimodal/Perception**
Description (Delphi Team)	Refers to the process(es) that perform computations on olfactory/ somatosensory/multimodal/perception data to construct and transform representations of the external environment, acquire information from, and make predictions about, the external world, and guide action.

How important do you think **Olfactory/Somatosensory/Multimodal/Perception** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important
- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Olfactory/Somatosensory/Multimodal/Perception** this way.

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CONSTRUCT	Declarative Memory
Description (RDoC)	Declarative memory is the acquisition or encoding, storage and consolidation, and retrieval of representations of facts and events. Declarative memory provides the critical substrate for relational representations—i.e., for spatial, temporal, and other contextual relations among items, contributing to representations of events (episodic memory) and the integration and organization of factual knowledge (semantic memory). These representations facilitate the inferential and flexible extraction of new information from these relationships.
Behaviour (RDoC)	Discrimination, Familiarity, Learning, Recall, Recognition

How important do you think **Declarative Memory** is to optimal performance in dynamic and high-pressure environments?

- Extremely important
- Very important
- Moderately important
- Slightly important
- Not important / NA
- Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Declarative Memory** this way.

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comments). For this reason, please ensure your comments are clear and use language that people outside of your field will understand. You will remain anonymous.

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CONSTRUCT	Language
Description (RDoC)	Language is a system of shared symbolic representations of the world, the self and abstract concepts that supports thought and communication.
Behaviour (RDoC)	Coherent discourse, Coherent sentences, Production and comprehension of words

How important do you think **Language** is to optimal performance in dynamic and high-pressure environments?

- Extremely important
- Very important
- Moderately important
- Slightly important
- Not important / NA
- Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Language** this way.

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The following questions ask you to rate the Subconstructs under the Construct **Cognitive Control**

DOMAIN	Cognitive Systems
CONSTRUCT	**Cognitive Control**
Description (RDoC)	A system that modulates the operation of other cognitive and emotional systems, in the service of goal-directed behaviour, when prepotent modes of responding are not adequate to meet the demands of the current context. Additionally, control processes are engaged in the case of novel contexts, where appropriate responses need to be selected from among competing alternatives.
Subconstructs	• Goal Selection, Updating, Representation, and Maintenance • Response Selection; Inhibition/Suppression • Performance Monitoring

How important do you think **Goal Selection; Updating, Representation, and Maintenance** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important
- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Goal Selection; Updating, Representation, and Maintenance** this way.

Please note that your comments here will be read by the research team and may be presented to all Delphi Panel members unless you select 'HIDDEN' in the following question (in which case only the research team will see the comments). For this reason, please ensure your comments are clear and use language that people outside of your field will understand. You will remain anonymous.

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CONSTRUCT	Cognitive Control
SUB-CONSTRUCT	**Response Selection; Inhibition/Suppression**
Description (Delphi Team)	The ability to select, inhibit and supress responses, particularly in novel situations where appropriate responses need to be selected amongst competing alternatives.
Behaviour (RDoC)	Distractibility, Impulsive behaviours, Off-task behaviours

How important do you think **Response Selection; Inhibition/Suppression** is to optimal performance in dynamic and high-pressure environments?

- Extremely important
- Very important
- Moderately important
- Slightly important
- Not important / NA
- Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Response Selection; Inhibition/Suppression** this way.

Please note that your comments here will be read by the research team and may be presented to all Delphi Panel members unless you select 'HIDDEN' in the following question (in which case only the research team will see the comments). For this reason, please ensure your comments are clear and use language that people outside of your field will understand. You will remain anonymous.

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How important do you think **Performance Monitoring** is to optimal performance in dynamic and high-pressure environments?

- Extremely important
- Very important
- Moderately important
- Slightly important
- Not important / NA
- Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Performance Monitoring** this way.
Please note that your comments here will be read by the research team and may be presented to all Delphi Panel members unless you select 'HIDDEN' in the following question (in which case only the research team will see the comments). For this reason, please ensure your comments are clear and use language that people outside of your field will understand. You will remain anonymous.

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The following questions ask you to rate the Subconstructs under the Construct **Working Memory**

DOMAIN	Cognitive Systems
CONSTRUCT	**Working Memory**
Description (RDoC)	Working Memory is the active maintenance and flexible updating of goal/task relevant information (items, goals, strategies, etc.) in a form that has limited capacity and resists interference. These representations: may involve flexible binding of representations; may be characterized by the absence of external support for the internally maintained representations; and are frequently temporary, though this may be due to ongoing interference. It involves active maintenance, flexible updating, limited capacity, and interference control.
Subconstructs	• Active Maintenance • Flexible Updating • Limited Capacity • Interference Control

CONSTRUCT	Working Memory
SUB-CONSTRUCT	**Active Maintenance**
Description (Delphi Team)	The ability to actively maintain one or more pieces of information as internal representations, which activates brain regions that are specific to the modality of the information being maintained. Active maintenance is one of the features which distinguished working memory from other cognitive processes.

How important do you think **Active Maintenance** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important
- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Active Maintenance** this way.

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CONSTRUCT	Working Memory
SUB-CONSTRUCT	**Flexible Updating**
Description (Delphi Team)	The ability to change and update goal/task relevant information (items, goals, strategies, etc.) in accordance with the task at hand.

How important do you think **Flexible Updating** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important
- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Flexible Updating** this way.

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CONSTRUCT	Working Memory
SUB-CONSTRUCT	**Limited Capacity**
Description (Delphi Team)	Reflect a major component of working memory impairment in many forms of psychopathology.

How important do you think **Limited Capacity** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important
- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Limited Capacity** this way.

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CONSTRUCT	Working Memory
SUB-CONSTRUCT	**Interference Control**
Description (Delphi Team)	The ability to maintain focus and stay on task whilst resisting interference. The ability to resist interference is made more difficult by behavioural data from a secondary task that uses the same modality or type of information being maintained in working memory. Many working memory tasks do not involve specific manipulations of interference, although it is often assumed that interference in always occurring via the influence of previous stimulus traces, stimulus response mappings, or other information in the environment. Interference control can be tested be the explicit presentation of competing information, goals or tasks.

How important do you think **Interference Control** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important

- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Interference Control** this way.

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Importance: Social Processes

DOMAIN: Social Processes

Description: **Systems for Social Processes** mediate responses to interpersonal settings of various types, including perception and interpretation of others' actions.

Constructs/Subconstructs

- Construct: Affiliation and Attachment
- Construct: Social Communication
  - Subconstruct: Reception of Facial Communication
  - Subconstruct: Production of Facial Communication
  - Subconstruct: Reception of Non-Facial Communication
  - Subconstruct: Production of Non-Facial Communication
- Construct: Perception and Understanding of Self
  - Subconstruct: Agency
  - Subconstruct: Self-Knowledge
- Construct: Perception and Understanding of Others

- Subconstruct: Animacy Perception
- Subconstruct: Action Perception
- Subconstruct: Understanding Mental States

Definitions of key terms.pdf

CONSTRUCT	Affiliation and Attachment
Description (RDoC)	Affiliation is engagement in positive social interactions with other individuals. Attachment is selective affiliation as a consequence of the development of a social bond. Affiliation and Attachment are moderated by social information processing (processing of social cues) and social motivation. Affiliation is a behavioural consequence of social motivation and can manifest itself in social approach behaviours. Affiliation and Attachment require detection of and attention to social cues, as well as social learning and memory associated with the formation of relationships. Affiliation and Attachment include both the positive physiological consequences of social interactions and the behavioural and physiological consequences of disruptions to social relationships. Clinical manifestations of disruptions in Affiliation and Attachment include social withdrawal, social indifference and anhedonia, and over-attachment.
Behaviour (RDoC)	Attachment Formation: Maintaining proximity, Preference for individual Attachment Maintenance: Distress upon separation

How important do you think **Affiliation and Attachment** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important
- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Affiliation and Attachment** this way.

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OPTIONAL: Please select 'HIDDEN' if you would like your above response to not be included in the anonymous pool of expert comments at the end of the iteration.

The following questions ask you to rate the Subconstructs under the Construct **Social Communication**

DOMAIN	Social Processes
CONSTRUCT	**Social Communication**
Description (RDoC)	A dynamic process that includes both receptive and productive aspects used for exchange of socially relevant information. Social communication is essential for the integration and maintenance of the individual in the social environment. This Construct is reciprocal and interactive, and social communication abilities may appear very early in life. Social communication is distinguishable from other cognitive systems (e.g., perception, cognitive control, memory, attention) in that it particularly involves interactions with conspecifics. The underlying neural substrates of social communication evolved to support both automatic/reflexive and volitional control, including the motivation and ability to engage in social communication. Receptive aspects may be implicit or explicit; examples include affect recognition, facial recognition and characterization. Productive aspects include eye contact, expressive reciprocation, and gaze following. Although facial communication was set aside as a separate sub-construct for the purposes of identifying matrix elements, social communication typically utilizes information from several modalities, including facial, vocal, gestural, postural, and olfactory processing.
Subconstructs	• Reception of Facial Communication • Production of Facial Communication • Reception of Non-Facial Communication • Production of Non-Facial Communication

CONSTRUCT	Social Communication
SUB-CONSTRUCT	**Reception of Facial Communication**
Description (RDoC)	The capacity to perceive someone's emotional state non-verbally based on facial expressions.
Behaviour (RDoC)	Behavioural observation/coding systems, Eye gaze detection, Identification of emotion, Implicit mimicry, Scanning patterns

How important do you think **Reception of Facial Communication** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important
- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Reception of Facial Communication** this way.

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CONSTRUCT	Social Communication
SUB-CONSTRUCT	**Production of Facial Communication**
Description (RDoC)	The capacity to convey one's emotional state non-verbally via facial expression.
Behaviour (RDoC)	Behavioural observation/coding systems, Eye gaze aversion/contact, Facial affect production, Head turning, Imitation of facial gestures, Joint attention, Reciprocal emotional expression, Reciprocal eye contact

How important do you think **Production of Facial Communication** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important
- ○ Moderately important

- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Production of Facial Communication** this way.

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CONSTRUCT	Social Communication
SUB-CONSTRUCT	**Reception of Non-Facial Communication**
Description (RDoC)	The capacity to perceive social and emotional information based on modalities other than facial expression, including non-verbal gestures, affective prosody, distress calling, cooing, etc.
Behaviour (RDoC)	Comprehension of emotional prosody, Comprehension of non-verbal gestures, Humour comprehension, Irony/sarcasm comprehension, Metaphor comprehension

How important do you think **Reception of Non-Facial Communication** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important
- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Reception of Non-Facial Communication** this way.

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OPTIONAL: Please select 'HIDDEN' if you would like your above response to not be included in the anonymous pool of expert comments at the end of the iteration.

CONSTRUCT	Social Communication
SUB-CONSTRUCT	**Production of Non-Facial Communication**
Description (RDoC)	The capacity to express social and emotional information based on modalities other than facial expression, including non-verbal gestures, affective prosody, distress calling, cooing, etc.
Behaviour (RDoC)	Crying/laughing, Gestural/postural expressions, Interactive play, Response to distress/separation distress, Speech (affective) prosody, Vocalizations

How important do you think **Production of Non-Facial Communication** is to optimal performance in dynamic and high-pressure environments?

- Extremely important
- Very important
- Moderately important
- Slightly important
- Not important / NA
- Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Production of Non-Facial Communication** this way.

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The following questions ask you to rate the Subconstructs under the Construct **Perception and Understanding of Self**

DOMAIN	Social Processes
CONSTRUCT	**Perception and Understanding of Self**
Description (RDoC)	The processes and/or representations involved in being aware of, accessing knowledge about, and/or making judgments about the self. These processes/representations can include current cognitive or emotional internal states, traits, and/or abilities, either in isolation or in relationship to others, as well as the mechanisms that support self-awareness, self-monitoring, and self-knowledge.
Subconstructs	• Agency • Self-Knowledge

CONSTRUCT	Perception and Understanding of Self
SUB-CONSTRUCT	**Agency**
Description (RDoC)	The ability to recognize one's self as the agent of one's actions and thoughts, including the recognition of one's own body/body parts.
Behaviour (RDoC)	Delusions of control, Evidence that one understands ownership of one's own body parts or action (thoughts/behaviours), Hallucinations, Stereotypic behaviours.

How important do you think **Agency** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important
- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Agency** this way.

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CONSTRUCT	Perception and Understanding of Self
SUB-CONSTRUCT	**Self-Knowledge**
Description (RDoC)	The ability to make judgments about one's current cognitive or emotional internal states, traits, and/or abilities.
Behaviour (RDoC)	Developmentally appropriate perception of one's competences, skills, abilities beliefs, intentions, desires, and/or emotional states

How important do you think **Self knowledge** is to optimal performance in dynamic and high-pressure environments?

- Extremely important
- Very important
- Moderately important
- Slightly important
- Not important / NA
- Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Self Knowledge** this way.

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The following questions ask you to rate the Subconstructs under the Construct **Perception and Understanding of Others**

DOMAIN	Social Processes
CONSTRUCT	**Perception and Understanding of Others**
Description (RDoC)	The processes and/or representations involved in being aware of, accessing knowledge about, reasoning about, and/or making judgments about other animate entities, including information about cognitive or emotional states, traits or abilities.
Subconstructs	• Animacy Perception • Action Perception • Understanding Mental States

CONSTRUCT	Perception and Understanding of Others
SUB-CONSTRUCT	**Animacy Perception**
Description (RDoC)	The ability to appropriately perceive that another entity is an agent (i.e., has a face, interacts contingently, and exhibits biological motion).
Behaviour (RDoC)	Ability to appropriately attribute animacy to other agents

How important do you think **Animacy Perception** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important
- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Animacy Perception** this way.

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CONSTRUCT	Perception and Understanding of Others
SUB-CONSTRUCT	**Action Perception**
Description (Delphi Team)	The ability to perceive the purpose of an action being performed by an animate entity.
Behaviour (RDoC)	Ability to identify what actions an agent is executing, Gaze following, Imitation, Mimicry

How important do you think **Action Perception** is to optimal performance in dynamic and high-pressure environments?

- Extremely important
- Very important
- Moderately important
- Slightly important
- Not important / NA
- Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Action Perception** this way.

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CONSTRUCT	Perception and Understanding of Others
SUB-CONSTRUCT	**Understanding Mental States**
Description (RDoC)	The ability to make judgments and/or attributions about the mental state of other animate entities that allows one to predict or interpret their behaviours. Mental state refers to intentions, beliefs, desires, and emotions.
Behaviour (RDoC)	Developmentally appropriate interpretations of other intentions, goals and beliefs

How important do you think **Understanding Mental States** is to optimal performance in dynamic and high-pressure environments?

- Extremely important
- Very important
- Moderately important
- Slightly important
- Not important / NA
- Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Understanding Mental States** this way.

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Importance: Arousal and Regulatory Systems

DOMAIN: Arousal and Regulatory Systems

Description: Arousal/Regulatory Systems are responsible for generating activation of neural systems as appropriate for various contexts, and providing appropriate homeostatic regulation of such systems as energy balance and sleep.

Constructs/Subconstructs

- Construct: Arousal
- Construct: Circadian Rhythms
- Construct: Sleep-Wakefulness

Definitions of key terms.pdf

CONSTRUCT	Arousal
Description (RDoC)	Arousal is a continuum of sensitivity of the organism to stimuli, both external and internal. Arousal: 1. Facilitates interaction with the environment in a context-specific manner (e.g., under conditions of threat, some stimuli must be ignored while sensitivity to and responses to others is enhanced, as exemplified in the startle reflex), 2. Can be evoked by either external/environmental stimuli or internal stimuli (e.g., emotions and cognition), 3. Can be modulated by the physical characteristics and motivational significance of stimuli, 4. Varies along a continuum that can be quantified in any behavioural state, including wakefulness and low-arousal states including sleep, anaesthesia, and coma, 5. Is distinct from motivation and valence but can covary with intensity of motivation and valence, 6. May be associated with increased or decreased locomotor activity, and 7. Can be regulated by homeostatic drives (e.g., hunger, sleep, thirst, sex).
Behaviour (RDoC)	Affective states, Agitation, Cognition, Emotional Reactivity, Eye Blink, Motivated Behaviour, Motor Activity, Sensory Reactivity, Startle, Waking

How important do you think **Arousal** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important

- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Arousal** this way.

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CONSTRUCT	Circadian Rhythms
Description (RDoC)	Circadian Rhythms are endogenous self-sustaining oscillations that organize the timing of biological systems to optimize physiology and behaviour, and health. Circadian Rhythms: 1. Are synchronized by recurring environmental cues; 2. Anticipate the external environment; 3. Allow effective response to challenges and opportunities in the physical and social environment; 4. Modulate homeostasis within the brain and other (central/peripheral) systems, tissues and organs; 5. Are evident across levels of organization including molecules, cells, circuits, systems, organisms, and social systems.
Behaviour (RDoC)	Drive-regulated behaviours, Locomotor activity, Masking, Neurobehavioral functions, Sleep-rated and waking behaviours, Sleep-wake

How important do you think **Circadian Rhythms** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important
- ○ Moderately important
- ○ Slightly important

- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Circadian Rhythms** this way.

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CONSTRUCT	Sleep-Wakefulness
Description (RDoC)	Sleep and wakefulness are endogenous, recurring, behavioural states that reflect coordinated changes in the dynamic functional organization of the brain and that optimize physiology, behaviour, and health. Homeostatic and circadian processes regulate the propensity for wakefulness and sleep. Sleep: 1. Is reversible, typically characterized by postural recumbence, behavioural quiescence, and reduced responsiveness; 2. Has a complex architecture with predictable cycling of NREM/REM states or their developmental equivalents. NREM and REM sleep have distinct neural substrates (circuitry, transmitters, modulators) and EEG oscillatory properties 3. Intensity and duration is affected by homeostatic regulation; 4. Is affected by experiences during wakefulness; 5. Is evident at cellular, circuit, and system levels; 6. Has restorative and transformative effects that optimize neurobehavioral functions during wakefulness.
Behaviour (RDoC)	Co-sleeping, Intermediate/ admixed sleep-wake states, Motor behaviours during sleep, Rest-activity patterns, Sensory arousal threshold, Sex-specific sleep behaviours, Sleep, Sleep deprivation and satiation, Sleep inertia, Sleep timing and variability, Sleep-dependent neurobehavioral functions, Wakefulness

How important do you think **Sleep Wakefulness** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important

- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Sleep Wakefulness** this way.

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Importance: Sensorimotor Systems

DOMAIN: Sensorimotor Systems

Description: Sensorimotor Systems are primarily responsible for the control and execution of motor behaviors, and their refinement during learning and development.

Constructs/Subconstructs

- Construct: Motor Actions
  - Subconstruct: Action Planning and Selection
  - Subconstruct: Sensorimotor Dynamics
  - Subconstruct: Initiation
  - Subconstruct: Execution
  - Subconstruct: Inhibition and Termination
- Construct: Agency and Ownership
- Construct: Habit - Sensorimotor
- Construct: Innate Motor Patterns

Definitions of key terms.pdf

The following questions ask you to rate the Subconstructs under the Construct **Motor Actions**

DOMAIN	Sensorimotor Systems
CONSTRUCT	**Motor Actions**
Description (RDoC)	A multifaceted construct comprising the processes that must be engaged during the planning and execution of a motor action in a context-appropriate manner. Component processes include action planning and selection, sensorimotor dynamics, initiation, execution, and inhibition and termination. Of note, these processes will often be recruited in conjunction with motivational processes described in other domains, as when appetitive motivations drive approach behaviours. This construct explicitly includes the modulation and refinement of actions during development and learning. The list of subconstructs is not intended to imply a specific order or sequence.
Subconstructs	• Action Planning and Selection • Sensorimotor Dynamics • Initiation • Execution • Inhibition and Termination

CONSTRUCT	Motor Actions
SUB-CONSTRUCT	**Action Planning and Selection**
Description (RDoC)	Processes whereby an individual engages a plan for spatial and temporal components of possible purposeful movements, which match internal and external constraints to achieve a goal. This may also include cost-benefit calculations in the development and selection of motor plans.
Behaviour (RDoC)	Conceptual Apraxia, Ideational Apraxia, Ideomotor Apraxia, Limb-Kinetic Apraxia

How important do you think **Action Planning and Selection** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important
- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Action Planning and Selection** this way.

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CONSTRUCT	Motor Actions
SUB-CONSTRUCT	**Sensorimotor Dynamics**
Description (RDoC)	Processes involved in the specification/parameterization of an action plan and program based on integration of internal or external information, such as sensations and urges and modelling of body dynamics. This process is continuously and iteratively refined via sensory information and reward-reinforced information.
Behaviour (RDoC)	Developmental Coordinate Disorder, Hyposensitivity, Weakness

How important do you think **Sensorimotor Dynamics** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important
- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Sensorimotor Dynamics** this way.

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CONSTRUCT	Motor Actions
SUB-CONSTRUCT	**Initiation**
Description (RDoC)	Processes involved in the initiation of a selected action plan; this may include timing of movement onset.
Behaviour (RDoC)	Apathy, Catatonic Stupor, Negative Symptoms, Psychomotor retardation, Stuttering

How important do you think **Initiation** is to optimal performance in dynamic and high-pressure environments?

- Extremely important
- Very important
- Moderately important
- Slightly important
- Not important / NA
- Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Initiation** this way.

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CONSTRUCT	Motor Actions
SUB-CONSTRUCT	**Execution**
Description (RDoC)	Processes involved in the actualization and adaptation of the action implementation.
Behaviour (RDoC)	Activity Level, Ehler Danlos S, Psychomotor retardation

How important do you think **Execution** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important
- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Execution** this way.

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CONSTRUCT	Motor Actions
SUB-CONSTRUCT	**Inhibition and Termination**
Description (RDoC)	Processes involved in the inhibition of motor plans, either before or after an action is initiated, and the sense that a motor plan has been successfully completed. The inhibition sub-construct is commonly operationalized as motor response inhibition and has conceptual overlaps with the Inhibition/Suppression subconstruct of the Cognitive Control construct within the Cognitive Systems domain.
Behaviour (RDoC)	Activity Level, Automatic Obedience, Catatonic Immobility, Catatonic Rituals, Negativism, Perseveration, Stereotypic behaviours, Tics, Utilization Behaviour

How important do you think **Inhibition and Termination** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important
- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Initiation and Termination** this way.

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CONSTRUCT	Agency and Ownership
Description (RDoC)	The sense that one is initiating, executing, and in control of one's volitional actions and their sensory consequences and the sense that one's body or body parts belong to oneself. This may include the comparison of the predicted and actual sensory consequences of one's action, awareness of the intention to move, temporal binding of self-generated action and their immediate effects, and attenuation of sensory consequences of self-generated actions.
Behaviour (RDoC)	Alien Hand Syndrome, Functional Movement Disorders, Neglect, Perceptions of External Control, Stereotypic behaviours, Tics

How important do you think **Agency and Ownership** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important

- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Agency and Ownership** this way.

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CONSTRUCT	Habit - Sensorimotor
Description (RDoC)	Learned stimulus-response mappings triggered by internal or external stimuli that are autonomous of the current value of the outcome or goal. Habits may include overlearned sequences. Habits are implicit and efficient, requiring few cognitive resources, but can also be maladaptive under novel circumstances. Habits are based on previous positively or negatively reinforced learning and commonly occur after extended learning. Both habit formation and expression are commonly operationalized within motor control systems. When habit formation is motivated by reward learning it overlaps with the Habit construct within the Positive Valence domain.
Behaviour (RDoC)	Compulsive behaviours, Stereotypic behaviours

How important do you think **Habit - Sensorimotor** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important
- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Habit - Sensorimotor** this way.

Please note that your comments here will be read by the research team and may be presented to all Delphi Panel members unless you select 'HIDDEN' in the following question (in which case only the research team will see the comments). For this reason, please ensure your comments are clear and use language that people outside of your field will understand. You will remain anonymous.

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CONSTRUCT	Innate Motor Patterns
Description (RDoC)	Unlearned action plans that may be triggered by internal or external stimuli. This can include such behaviours as stereotyped expressions of affect, orientation to salience, innate approach and withdrawal phenomena, and startle responses.
Behaviour (RDoC)	Disinhibition of early motor reflexes, Incontinent Affect, Startle, Stereotypic behaviours

How important do you think **Innate Motor Patterns** is to optimal performance in dynamic and high-pressure environments?

- Extremely important
- Very important
- Moderately important
- Slightly important
- Not important / NA
- Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Innate Motor Patterns** this way.

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Importance: Expert Suggested Constructs

Expert Suggested Constructs

Constructs:

- Shifting
- Processing Speed
- Discomfort Tolerance

Definitions of key terms.pdf

CONSTRUCT	Shifting
Description (Delphi Team)	The ability to flexibly switch back and forth between tasks or mental sets.

How important do you think **Shifting** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important
- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Shifting** this way.
Please note that your comments here will be read by the research team and may be presented to all Delphi Panel members unless you select 'HIDDEN' in the following question (in which case only the research team will see the

comments). For this reason, please ensure your comments are clear and use language that people outside of your field will understand. You will remain anonymous.

OPTIONAL: Please select 'HIDDEN' if you would like your above response to not be included in the anonymous pool of expert comments at the end of the iteration.

CONSTRUCT	Processing speed
Description (Delphi Team)	The speed with which an individual processes many types of information.

How important do you think **Processing Speed** is to optimal performance in dynamic and high-pressure environments?

- Extremely important
- Very important
- Moderately important
- Slightly important
- Not important / NA
- Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Processing Speed** this way.

Please note that your comments here will be read by the research team and may be presented to all Delphi Panel members unless you select 'HIDDEN' in the following question (in which case only the research team will see the comments). For this reason, please ensure your comments are clear and use language that people outside of your field will understand. You will remain anonymous.

OPTIONAL: Please select 'HIDDEN' if you would like your above response to not be included in the anonymous pool of expert comments at the end of the iteration.

CONSTRUCT	Discomfort tolerance
Description (Delphi Team)	The ability to sit with uncomfortable emotions, states, and sensations (includes stress, boredom, pain, and other negative affective states).

How important do you think **Discomfort tolerance** is to optimal performance in dynamic and high-pressure environments?

- ○ Extremely important
- ○ Very important
- ○ Moderately important
- ○ Slightly important
- ○ Not important / NA
- ○ Don't know / Unsure

Feel free to provide your rationale or reasoning for rating **Discomfort Tolerance** this way.
Please note that your comments here will be read by the research team and may be presented to all Delphi Panel members unless you select 'HIDDEN' in the following question (in which case only the research team will see the comments). For this reason, please ensure your comments are clear and use language that people outside of your field will understand. You will remain anonymous.

OPTIONAL: Please select 'HIDDEN' if you would like your above response to not be included in the anonymous pool of expert comments at the end of the iteration.

Remove / edit prev suggested construct

EDIT CONSTRUCT EXERCISE SUGGESTIONS

In light of voting on all RDoC constructs, would you like to remove or edit any of your previous suggestions? (See here for the complete list of constructs you have just voted on for a refresher)

	Remove	Edit	No, neither
${q://QID41/ChoiceTextEntryValue/2}	○	○	○

	Remove	Edit	No, neither
${q://QID44/ChoiceTextEntryValue/2}	○	○	○
${q://QID45/ChoiceTextEntryValue/2}	○	○	○
${q://QID46/ChoiceTextEntryValue/2}	○	○	○
${q://QID47/ChoiceTextEntryValue/2}	○	○	○

You selected that you wish to edit ${q://QID41/ChoiceTextEntryValue/2} construct. Please detail your edits in the boxes below.

New name of construct:

New definition / description of suggested construct:

New application to Optimal performance:

You selected that you wish to edit ${q://QID44/ChoiceTextEntryValue/2} construct. Please detail your edits in the boxes below.

New name of construct:

New definition / description of suggested construct:

New application to Optimal performance:

You selected that you wish to edit ${q://QID45/ChoiceTextEntryValue/2} construct. Please detail your edits in the boxes below.

New name of construct:

New definition / description of suggested construct:

New application to Optimal performance:

You selected that you wish to edit ${q://QID46/ChoiceTextEntryValue/2} construct. Please detail your edits in the boxes below.

New name of construct:

New definition / description of suggested construct:

New application to Optimal performance:

You selected that you wish to edit ${q://QID47/ChoiceTextEntryValue/2} construct. Please detail your edits in the boxes below.

New name of construct:

New definition / description of suggested construct:

New application to Optimal performance:

Construct Suggestion 2

INSTRUCTION
SUGGESTING CONSTRUCTS

In light of completing the survey, you may suggest additional constructs.
When deciding on these constructs, please consider;

1. Is the construct multifaceted (can it be broken down into smaller constructs/ building blocks)? If so, list the building block constructs instead and provide comment on the greater latent construct you are considering.

2. If it applies to optimal performance in dynamic and high-pressure environments.

Please provide your best description and reasoning for listing the construct. This will be read by the research team who will synthesise the construct according to your description and either match it to an RDoC construct or consult relevant literature to elect it as an additional construct. If an additional construct, the construct will be included in the second iteration of the Delphi survey. The research team will be in contact with you to confirm interpretation of the construct after results have been collected.

Please also select the tick box according to whether you believe the nominated construct is applicable to individual performance (construct important to the one person) or interactional performance (the construct applies in a setting where another person is involved in some capacity).

See here for the complete list of constructs you have just voted on for a refresher.

Do you have a construct to suggest?

- ○ Yes
- ○ No

Construct Suggestion 1:

Contruct Suggestion 1	
Definition / description of suggested construct	
Application to Optimal performance	

Is this construct applied to optimal performance involving only one person (individual), two or more people (interactional), or can it be applied to both?

- ○ Individual
- ○ Interactional
- ○ Both: Individual and Interactional

Do you have an additional construct to suggest?

- ○ Yes
- ○ No

Construct Suggestion 2:

Contruct Suggestion 2	
Definition / description of suggested construct	
Application to Optimal performance	

Is this construct applied to optimal performance involving only one person (individual), two or more people (interactional), or can it be applied to both?

- ○ Individual
- ○ Interactional
- ○ Both: Individual and Interactional

Do you have an additional construct to suggest?

- ○ Yes

- ○ No

Construct Suggestion 3:

Contruct Suggestion 3	
Definition / description of suggested construct	
Application to Optimal performance	

Is this construct applied to optimal performance involving only one person (individual), two or more people (interactional), or can it be applied to both?

- ○ Individual
- ○ Interactional
- ○ Both: Individual and Interactional

Do you have an additional construct to suggest?

- ○ Yes
- ○ No

Construct Suggestion 4:

Contruct Suggestion 4	
Definition / description of suggested construct	
Application to Optimal performance	

Is this construct applied to optimal performance involving only one person (individual), two or more people (interactional), or can it be applied to both?

- ○ Individual
- ○ Interactional
- ○ Both: Individual and Interactional

Do you have an additional construct to suggest?

- ○ Yes
- ○ No

Construct Suggestion 5:

Contruct Suggestion 5	
Definition / description of suggested construct	
Application to Optimal performance	

Is this construct applied to optimal performance involving only one person (individual), two or more people (interactional), or can it be applied to both?

- ○ Individual
- ○ Interactional
- ○ Both: Individual and Interactional

Review

Would you like to review all of your ratings?

- ○ Yes
- ○ No, I'd like to submit all