Going With the Flow: Achieving Peak Performance in Surgery

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BACKGROUND: Flow, a heightened state of focus, confers performance benefits across many disciplines. Yet, despite persistent anecdotal evidence, relatively little is understood regarding flow's impact on surgical performance. The factors mitigating and promoting flow amongst surgeons in the workspace are also unclear.

OBJECTIVE: In this article, we discuss recent experimental evidence in surgical training programs supporting a positive effect of flow states on performance. We then describe the environmental, psychological and biological factors affecting surgeons' ability to achieve flow. Finally, we discuss practical steps surgeons can take towards achieving flow and suggest future directions for research into flow in surgery. (J Surg Ed 82:103593. © 2025 The Author(s). Published by Elsevier Inc. on behalf of Association of Program Directors in Surgery. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/))

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COMPETENCY: Medical knowledge

Surgery requires a high degree of skill, focus, and the ability to regulate one's emotions under stressful conditions. In the operating theatre, one is tasked with making life-altering decisions and performing technically complex procedures, whilst working and communicating with the surgical team. The ability to do so is crucially dependent on the surgeon's psychological state, with certain mental states affecting a surgeon's cognitive abilities, decision-making processes, and manual dexterity.[1] This is particularly important given the high prevalence of exhaustion, burnout and stress among surgeons which may affect performance.[2]

Flow is a psychological state of altered cognition where an individual becomes fully immersed in their current activity. Often referred to as being "in the zone," flow states are characterized by periods of intense concentration, heightened control, and a distorted sense of time, often leading to improved performance.[3] Flow states can occur during any activity, provided the individual has clear goals, a balance between challenges and capacities, and the presence of immediate feedback,[3] conditions often present when performing surgery. The relationship between surgery and flow was first made almost 40 years ago, where experiencing flow in surgery was found to be subject to many factors including experience, specialty, type of practice, and individual skills.[4] This is reflected through anecdotal accounts from surgeons commonly describing the intense focus and altered perception that are hallmarks of the flow state.[5,6] More recently, studies employing virtual reality (VR) provide experimental evidence towards the benefits of flow upon surgical performance. Surgical novices for example, demonstrate a positive association between flow state score and both surgical performance and intrinsic motivation.[7] These improvements are associated with psychobiological changes brought on by the flow state. For example, experiencing flow significantly reduced heart rate during training and decreased mental strain in a VR laparoscopic surgery simulation. This both improved surgical performance and enhanced the surgeon's experience of the procedure.[8] In a separate study, compared to low performers, high VR performers reported increased subjective flow experience,[9] associated with a lower heart rate and higher theta activity—a brain wave pattern associated with relaxation and alterations in autonomic nervous system activity.[10] The study therefore highlights the importance of a relaxed state for

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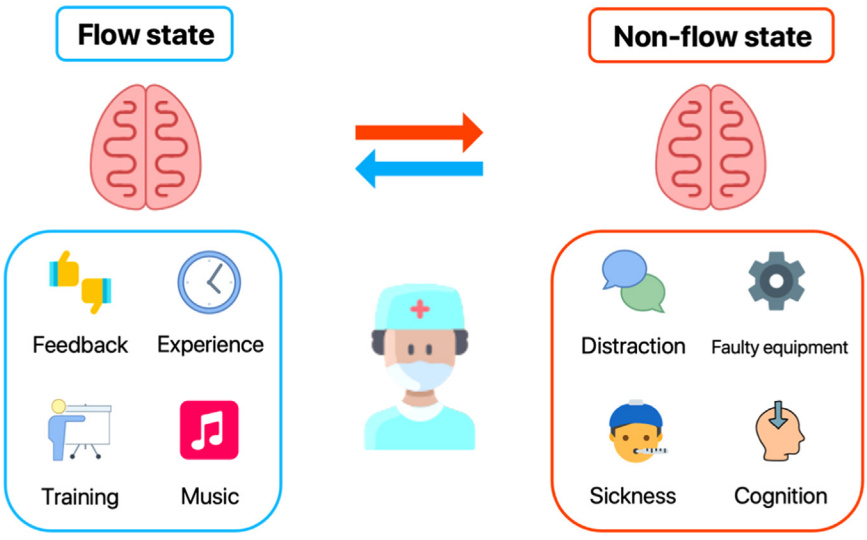

FIGURE 1. Factors promoting and mitigating against flow in surgery.

achieving high performance in surgery. The preliminary evidence suggests flow states can lead to improved surgical performance, with implications for both experienced and trainee surgeons. Can surgeons utilize this state more readily? Are there specific conditions that make flow more or less likely? Experiencing flow in surgery is ultimately a multi-dimensional construct, affected by physical, cognitive, physiologic, affective, social, cultural, and environmental factors[5] (Fig. 1). Interventions to enhance flow in surgery can therefore be tailored to address these specific dimensions.[11,12] For example, physiological states of injury, fatigue and sleep loss may impede flow by affecting one's cognition.[13] Rest zones—spaces where surgeons can relax following surgical operations—are found to lower stress and improve mood.[14] Rather than inducing flow, these zones may support flow indirectly by supporting recovery between procedures. Surgeons also routinely face flow disruptions from their environment. These can stem from multiple sources including unwanted communication, unexpected patient complications, or equipment malfunctions, all of which divert members of the surgical team from their primary task. Whilst some flow disruptions are unavoidable, those associated with communication, coordination and training can be mitigated through better management by the lead or by others in the surgical team. Indeed, Csikszentmihalyi's initial report describes the need for surgeons to develop skills relating to 'emotional, managerial, and cognitive abilities required to orchestrate the team' for achieving flow.[4] The operating theatre itself can also be adapted to foster a sense of calm and tranquility. Playing music has been a common strategy within operating rooms for decades, reducing stress and anxiety for both medical team and patient,[15] and improving surgical performance.[16]

Flow can be fostered in part by adapting one's environment to evoke the right psychological and physiological conditions. However, flow is also deeply influenced by the emotions and feelings surgeons experience during the surgical procedure itself. Trainee surgeons in particular, with limited automaticity and experience may find it difficult to enter flow states due to inherent stressors. To this end, virtual reality (VR) training represents an ideal candidate, providing many of the pre-requisites for flow,[17] and stimulating feelings of immersion and engagement akin to the operating theatre. Furthermore, specific task components can also be dynamically changed to best promote flow and engagement. For example, goal-related information and performance feedback can be provided immediately by the simulator itself, or in cases necessitating human feedback, by the instructor at specific points. Intelligent tutoring systems can further automate task difficulty based upon performance,[18] whilst neuro- and biofeedback may be used to develop emotion regulation skills.[19] These approaches have shown promising results for improving surgical performance and reducing time on task.[20]

Flow states are multi-dimensional and can be more readily achieved by environmental (e.g., music, feedback) and experiential factors. On the other hand, distractions from other people and equipment, ill health and attenuated cognition may prevent flow.

Our commentary examines the relationship between psychological flow states and surgical performance, providing practical insights into how these states can be fostered within surgical environments. Yet, despite growing interest in this area, current research on flow in surgery faces several important limitations. Crucially, the studies cited, whilst demonstrating the benefits of flow in VR training, have not determined whether this

translates to the operating theatre. Little is also known regarding the influence of personal factors and—more pertinent to surgery—environmental factors such as team dynamics or surgical complexity on achieving flow. Relatedly, whilst evidence suggests that flow is more readily achieved among senior surgeons and high performers, the causal relationship remains unclear. Do flow states enhance performance, or do high-performing surgeons simply experience flow more frequently?

Whilst some components of surgery present measurement challenges, structured research can identify key factors influencing flow states and their impact on performance. Randomized controlled trials are particularly promising, whereby surgeons' biological and mental states are assessed after being exposed to different interventions. Similar experimental designs could be applied to surgical trainees to compare those completing flow-oriented training versus traditional approaches. For surgeons looking to improve flow experiences in their daily work, one can seek to improve their personal habits and working environment. At the individual level, maintaining one's physical and emotional health is vital, both being positively associated with the flow experience.[21] To this end, getting adequate sleep, eating properly, and staying physically active is suggested for surgeons anecdotally,[13] whilst simple stress-reduction techniques including breathing exercises and meditation are known to reduce anxiety and promote flow.[22,23] On-the-other-hand, making changes to ones' working conditions including rest zones and scheduling may be less under a surgeons' control. Therefore, it is important that senior figures are educated regarding best working practices, recognizing that optimizing conditions benefits surgical outcome and team satisfaction.

Surgeons have plentiful opportunities for flow due to the ideal balance between the demanding nature of their role and their skill level. Preliminary evidence suggests flow can be instilled though personal habits, surgical training, and adapting one's environment. Yet, it remains an overlooked component of surgery despite the potential impact on performance. Ultimately, flow states in surgery represent a novel, exciting field of study meriting further investigation.

STATEMENTS AND DECLARATIONS

Manuscript Category

Perspectives

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