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BEYOND DEADLINE PRESSURE: TRANSFORMING STRESS INTO CREATIVE FLOW

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ABSTRACT

This paper explores the relationship between stress, creativity, and flow in creative professions with deadlines. Drawing upon extensive industry experience, empirical research, and a case study of animation students in virtual production, we examine how deadline stress in combination with precursors for flow, can enhance creativity by transforming a task into a challenge. The research is grounded in flow theory and stress theory. Challenge stressors prime the prefrontal cortex for a nuanced interplay between divergent and convergent thinking, engaging alternate neural networks and a powerful co-operation between the conscious and subconscious. Flow maintains optimal performance, yet is enjoyable and fulfilling, increasing artist wellbeing and creative output. However, long term sustained flow may have risks of burnout and addiction. Research is needed to foster creative flow in the workplace, including how to tailor challenges and integrate relaxation. This paper contributes to the ongoing discourse on creativity in high-pressure environments, offering insights for both academic research and practical application in creative industries.

Keywords: Stress transformation, creative flow, flow theory, challenge stressors, psychological capital, animation pedagogy, cognitive neuroscience, virtual production, gamification, creative industries

INTRODUCTION

This paper investigates the complex relationship between deadline stress and creativity within creative professions. It posits that deadline stress needs a particular set of carefully balanced conditions in order to enhance creativity, and that the mechanism underlying this increase in creativity is flow. *"Creativity and improved well-being have been empirically linked to the flow experience"* (Chilton, 2013, p. 64). Moreover, if flow is intrinsic to this phenomenon, we can use our understanding of the conditions that support it, in order to mitigate any negative effects of deadline stress on creativity. A better understanding of this dynamic could help inform best practice in creative industries where deadline pressure is used.

My investigation is grounded in flow theory and its implicit relationship with Stress Theory, in particular challenge stressors. Flow is an enjoyable psychological state where one is completely immersed and engaged in an activity, performing at an optimum level. Research suggests a parallel between the dynamics of stress in both flow and creativity. Could they stem from the same neurological mechanisms, possibly ingrained in our biological evolution?

In 2022, after many years in the animation industry, I transitioned to academia, bringing with me countless experiences of creativity under deadline pressure. One Saturday morning, what was supposed to be a quick stop at work turned into a 24-hour challenge, creating visual effects that transformed a yellow brick road into a swarm of butterflies and a wooden barn getting sucked into a tornado. This daunting task was met with a unique blend of clear direction, support, trust, and autonomy from my VFX supervisor, setting the stage for what I believe, became a deep dive into flow, and a valuable lesson on coming in to work when you have the day off.

Such experiences, where creativity seems to flourish under deadline stress, prompted me to question what else is going on. Could the right kind of stress, under the right conditions, be essential in achieving what Csikszentmihalyi describes as the flow state, which in turn drives creativity? Flow is described as enjoyable and effortless, hardly stressful. This paper is born out of that paradox, driven by my professional creative journey with the insights that has afforded me, and motivating my broader academic inquiry and quest to find some answers. My investigation is also supported by a case study of third-year animation students undertaking two creative projects under deadline pressure, analysed through post-project surveys.

THE GOLDILOCKS ZONE

Is the positive relationship between stress and creativity in creating specific conditions that induce flow? Stressors activate alternate neural networks that may play a complex role in maintaining creative flow. Creativity may also have deep psychological roots related to resolving the tension we feel between the way the world is and how we would like it to be. There are many variables that can influence the interplay between stress, creativity, and flow, and the balancing act required for the relationship to be positive is where I focus my attention in this paper.

WHERE TO NEXT?

Firstly, let's better understand the relationship between stress and creativity. Are there any correlations between the conditions for flow and the variables that support creativity under stress? We follow a case study of third-year animation students, exploring some real-world insight into these ideas. Our analysis then attempts to find the mechanisms that promote creativity under deadline stress, and whether these directly relate to flow. Finally, we consider the ethical implications of using stress as a management tool. Anxiety can have a very negative impact on wellbeing and productivity. If deadline stress is understood as a catalyst for flow, which in turn

produces creativity, perhaps the focus of creative managerial practice may shift to fostering flow rather than stress?

DEADLINE PRESSURE

During the production of *The Death Cure (2018)*, the final film in the *Maze Runner* (2014) series, I was privileged to work in Weta's Art Department conceptualising the city walls, gates and tower guns, drawing inspiration from brutalist architecture, as well as designing futurist city buildings. I was faced with a tight schedule and a shift in artistic direction and had to work quickly. Despite the looming deadlines, I found the experience extremely enjoyable and surprisingly free from stress. I would often lose track of time and become completely engrossed in the tasks I was given. In this instance, where the work was intrinsically engaging, I found the time pressure helped me to focus and pushed my creative skills.

When I returned to the Models Department, the task of building my Art Department designs did not feel the same. The creative challenges were largely resolved, leaving a series of technical steps that were demanding due to their volume rather than complexity or creative difficulty. This made it harder to stay engaged within a similar schedule. This time the deadline stress did not help me focus, or push my creativity.

In Creativity Under the Gun (Amabile et al., 2002), the relationship between creativity and deadline pressure is explored. The authors found that deadline pressure's effect on creativity can vary. High pressure days that were conducive to creativity had tasks that were characterised by clear goals and a meaningful sense of urgency. On these days, the participants felt they were 'on a mission'. Whereas high pressure days that stifled creativity were marked by a lack of focus, no clear purpose, constantly switching between tasks and the feeling of being on a treadmill. The recommendations from the study were to advise managers to avoid imposing extreme time pressure where possible and mitigate the negative effects of time related stress by providing an environment that enabled people to maintain focus and engagement, and to avoid switching tasks.

All of the studies I investigated suggest that the relationship between stress and creativity is complex and nuanced and further research is needed. There are many variables, the type of stressor, the level of stress, the time under stress, psychological and neurological differences between individuals, environmental factors, culture as well as all the ways that these variables can interact. All of these elements can help determine whether a stressor will increase, decrease or have no effect on creativity.

Even though current research shows that the relationship between stress and creativity is unclear, complex and nuanced, the notion that some stress can increase creative performance has become embedded in managerial psychology. This idea is based on the Yerkes-Dodson Law which suggests that as arousal increases with stress, performance improves because individuals become more focused, alert, and attentive, but there is a tipping point where too much arousal interferes with cognitive processes, and performance then declines, following an inverted 'U' curvilinear relationship.

There is some evidence to support this hypothesis, but many other variables are involved. It is much more complicated than this original proposal formulated in 1908 (Corbett, 2015). The notion that some stress is beneficial for performance needs critical evaluation and should be rejected in favour of more useful and accurate concepts (Le Fevre et al., 2003). This generalised sentiment does not reflect the nuance and complex interplay of all the elements involved. So, what are the variables that determine whether a stressor will be a challenge or a hindrance to creativity?

Creative time pressure (time pressure to come up with innovative, creative solutions) has been shown to have this

curvilinear, inverted 'U' relationship with creativity, particularly when an individual has high openness to experience (broad mindedness and a propensity to seek out new experiences) and is in a supportive environment (Baer & Oldham, 2006). Time pressure alone was not enough, in this case the task is intrinsically creative and the individual is not afraid to try something new, in fact they like that idea.

Job stress is a lot more likely to positively influence creativity when an individual has the necessary psychological resources – or psychological capital (PsyCap). The impact of the positive components of stress on creativity is shown to be increased in individuals with high PsyCap (Guo et al., 2018).

> *"Low PsyCap individuals lack the psychological reservoir of resources to best cope and leverage job stress to creativity gains…only those with high psychological resources appear able to turn the detrimental effects of job stress to a benefit, at least toward creativity"*(Ghafoor & Haar, 2022, p. 655).

PsyCap contains these elements:

1) self-efficacy - confidence in one's ability to achieve goals
2) optimism - positive expectation about future outcomes
3) hope - perseverance towards goals and finding paths to achieve them
4) resilience - ability to bounce back from adversity and challenges.

It is interesting to note that hope is distinctly profound in its effect compared with the other components of PsyCap. Individuals with a strong sense of hope are not only confident in their ability to achieve their goals but are adept at identifying paths to overcome obstacles in the creative process. This combination of willpower with problem solving gives an individual the motivation to initiate action as well as flexibility when approaching creative tasks. Hope appears to be a critical psychological resource for creativity (Sweetman et al., 2011).

Barbara Fredrickson's 'Broaden and Build Theory' has been found to help develop PsyCap and visa-versa, particularly regarding resilience (Luthans et al., 2006) but also self-efficacy, hope and optimism (Carmona–Halty et al., 2019). It proposes that experiencing positive emotions leads to broader cognitive processes building physical, intellectual, and social resources, enhancing wellbeing and an ability to thrive. Could production environments in deadline-driven creative industries like animation, increase their creative productivity by adopting processes that support broaden and build, and promote their artists' PsyCap?

How external conditions are structured can significantly impact an individual's creative output (Deci & Ryan, 1987). A work culture that supports creativity through encouragement, resources, and recognition of creative efforts can foster PsyCap and creativity. When the leadership team values and actively promotes innovation it plays a critical role in this process (Shalley & Gilson, 2004).

Increased PsyCap helps employees to view the demands of their job as challenges. Time pressure can be seen as a challenge provided that employees have enough control over their work, and view their work environment as supportive and empowering rather than restrictive and stressful. This can significantly influence their ability to be creative and proactive (Ohly & Fritz, 2010). Leadership styles welcoming creative input and respecting the artist's creative agency while still maintaining the ability to lead are shown to be positively associated with creativity. As an animation director, if I was looking at a first pass of an animation performance, and it was not what I had imagined. I would first attempt to understand what the animator was trying to achieve, then see whether it might work and if not, how I could steer it back on course while still incorporating as much of their creative input

as would benefit the piece. I learned how to do this over time, and I saw that it not only helped with creative engagement, but also in getting the artist aligned with my direction.

Means efficacy, or the belief in the usefulness of external resources, can also enhance the ability to perform creatively (Simmons et al., 2014). Conversely, overly critical, dismissive workplaces that do not value innovation will hinder creative efforts. Fear of failure and criticism is generally discouraging for creatives (Jin Nam Choi et al., 2009).

Negative connections between stress levels and creativity have been found with stress induced by problematic interpersonal relations in an organisation, as well as rigid hierarchical structures and stressful work culture. For creativity to flourish these types of stresses need to be reduced (Talbot et al., 1992). External conditions where pressure increases to a level where you feel threatened, or judged, or overly concerned with avoiding negative feedback, can make you too anxious to think creatively. This type of stress is referred to as 'High Evaluative Stress' and is not good for creative thinking (Byron et al., 2010).

FLOW AND DEADLINE STRESS

Those times in my career when tight production deadlines led to creativity rather than anxiety, often felt like 'being in the zone'. On reflection, many other factors needed to align to make this happen. Being able to view the task as an engaging challenge, having creative agency, positive feedback and clear goals, are all known facilitators of this altered state of mind, also known as flow.

Mihaly Csikszentmihalyi first introduced the term "flow" in the 1970s, to describe a state of optimal experience where people are fully immersed and focused on a task. "*Concentration is so intense that there is no attention left over to think about anything irrelevant, or to worry about problems"*(Csikszentmihalyi, 1990, p. 71). They also experience a sense of effortlessness and enjoyment, often losing track of time. He describes a task that induces this state as "*An activity that produces such experiences is so gratifying that people are willing to do it for its own sake, with little concern for what they will get out of it, even when it is difficult, or dangerous"*(Csikszentmihalyi, 1990, p. 71). His work has been pivotal in understanding how flow contributes to creativity, productivity, and overall wellbeing, which is one of the reasons why it is so important in psychology.

Flow itself does not feel stressful; how can deadline pressure have a role in producing this state? According to The Psychology of Optimal Experience, *"The best moments usually occur when a person's body or mind is stretched to its limits in a voluntary effort to accomplish something difficult and worthwhile. Optimal experience is thus something that we make happen"*(Csikszentmihalyi, 1990, p. 3).

These quotes suggest that flow is achieved not in passive, relaxed moments, but through active engagement in challenging, intrinsically rewarding tasks where the balance between skill level and challenge creates a sense of effortless immersion and enjoyment. Flow needs a challenge, moderate stress is an essential requirement, along with other specific conditions, that interact together to create a deeply satisfying and enjoyable altered state. Is flow the reason why we sometimes observe increased creativity under time pressure?

FLOW AND CREATIVITY

Many studies have found critical relationships between flow and creativity. In musical composition it's a well-known phenomenon. Composers fully engaged and enjoying their work, in a state of flow, have been shown to not only be more creative but also produce higher quality compositions (MacDonald et al., 2006). The lift in creativity is not limited to music though. Experiencing flow is seen as a core element in making visual

art. Artists frequently find themselves in deep concentration, losing track of time and self-awareness when engaged in their practice. The experience they describe matches the flow state and is seen as vital to enable and guide their work. It enables artists to fully express themselves (Chemi, 2016).

In *The relation of flow-experience and physiological arousal under stress - can u shape it?* (Peifer et al., 2014), the researchers found the relationship between flow and physiological arousal under stress also follows the inverted U-curve of the Yerkes-Dodson Law - skill level and task difficulty must be carefully balanced. If the challenge is too easy, people become bored, while if it's too difficult, they can become anxious. This alignment facilitates deep immersion in the activity, enabling a more profound exploration of creative ideas and solutions (Chilton, 2013).

Flow enhances creativity, and moderate stress, or to be more precise, a challenge stressor, will facilitate flow. How do we discern whether a stressor will hinder our creativity or be seen as an exciting challenge? The subjective perception of the individual is a major variable in how stress is viewed (Lazarus & Folkman, 20). Those with high PsyCap are more likely to see stressful situations as a challenge, and continue to perceive them this way for a longer time than those with lower PsyCap (Feng et al., 2022). Therefore, increased PsyCap facilitates flow. It is also facilitated by clear goals, regular feedback, intrinsically rewarding tasks and a sense of autonomy. All of these observations align well with our hypothesis that flow is the underlying mechanism behind the observed increase in creativity under stress.

In *Creativity Under the Gun,* the researchers noted that high stress days conducive to creativity had tasks with clear goals and a sense of urgency that was meaningful. They recommended providing an environment that maintains focus and engagement, and to avoid switching tasks when creatives are under time pressure. This sounds very much like the conditional requirements for flow, which are characterised by clear goals, regular feedback and intrinsically rewarding tasks. Constantly switching tasks could break flow by disturbing the underlying neural processes, and also have a negative long-term effect on the artist's sense of control.

A study in March 2024 that used neuroimaging to explore the neural basis for flow in jazz improvisation found that high creative flow states correlated with transient deactivation in areas typically associated with executive processing, like prefrontal networks. High flow states also involved less activity in the default mode network (DMN). These high flow states were judged by both experts and the musicians to be superior performances. The study found that having the necessary expertise was also critical for this process to work (Rosen et al., 2024).

Stress weakens prefrontal networks, possibly making the brain more susceptible to entering alternative states of consciousness, such as flow, where cognitive and creative processes are enhanced (Arnsten, 2015). Under stress, there's a reduced coupling within the default mode network and increased coupling with the salience network, which may create heightened awareness and readiness to respond to stimuli and which is beneficial for focussing attention on immediate tasks (Sripada et al., 2012). Stress-induced cognitive interference deactivates areas within the dorsolateral prefrontal cortex (DLPFC) in the brain. The DLPFC is crucial for problem-solving, planning, inhibition control, decision-making, attention, emotional regulation and social awareness. Deactivation of the DLPFC may foster creativity by allowing more spontaneous associations and novel insights (Pinho et al., 2015). Stress can thus enhance divergent thinking which facilitates creativity, particularly ideation.

Creative thinking is multifaceted, there is also a need to recognise patterns and problem solve. This is when the DLPFC's executive powers and information filter are needed again. We need to turn to convergent rather than divergent thinking. This

type of convergent creativity requires bringing information together and making sense out of it. In 2015, a study found that activating the DLPFC to promote convergent thinking and creative synthesis did in fact increase convergent creativity but only if the participants were primed for divergent thinking first (Colombo et al., 2015). If the DLPFC was not primed for divergent thinking first, then convergent creativity would not increase; this is an important point.

Interestingly, some studies show that the DLPFC may also play a role in controlling some stress responses (Era et al., 2021). Stimulation of the left DLPFC can help to attenuate physiological stress reactions (Remue et al., 2016). It may also be involved in regulating cortisol levels for stress recovery, rather than just being passively affected by stress (Wang et al., 2023) Stress' role might be to prime the brain for divergent thinking as well as engage alternate neural networks but then the other conditions that facilitate flow, like clear goals, intrinsic reward, feedback and skill level, restore the balance required for convergent processing and optimal performance.

Direct evidence linking flow conditions to DLPFC stimulation is limited, but the known functions of the PFC with cognitive control, attention and emotional regulation suggest that activities conducive to flow are likely to stimulate this region (León-Domínguez & León-Carrión, 2019). Some functional neuroimaging studies have shown that flow states are associated with increased activity in the PFC or prefrontal cortex (Yoshida et al., 2014). There is also evidence for clear goals helping to synchronise neural activity in the cerebellum and basal ganglia, which are crucial for integrating sensory input with motor responses (Gold & Ciorciari, 2021). These are networks associated with flow.

Remember, 'Hope' in terms of PsyCap, is defined as "perseverance towards goals and finding paths to achieve them"? This is a type of cognitive persistence. If stress weakens the prefrontal networks, then cognitive persistence might come to their aid. Perhaps 'Hope' in PsyCap is a critical resource for sustaining convergent problem-solving under divergent dominant neural networks. However, these ideas are speculative and require further research and empirical evidence.

The interaction of processes in the brain when in flow are finely balanced. One theory sees creativity as a fundamental process rooted in our biology, helping us make sense of the world by resolving tensions between what is and what could be (Levis, 2020). Challenge stressors might not just push the individual into a state of arousal conducive to flow but also engage deeper, perhaps more primal, cognitive processes conducive to creative thinking. The state of complete absorption in a task associated with positive experience (flow) and often experienced during creative activities, may implicate an integration between conscious and subconscious processes (Biasutti, 2011). The unconscious mind can process around 11 million bits per second whereas the conscious mind sits at about 50 bits per second. These speeds are used metaphorically, as exact measurement in bits for brain processing would be complex and imprecise; however, it is demonstrated with conscious awareness lagging behind subconscious perception by about half a second, even though our subjective experience doesn't feel that way (Wiliam, 2006). Imagine the creative power of a subconscious given clear goals from the conscious mind.

RESEARCH GAPS

Despite extensive research into stress, creativity, and flow, there remains a significant gap in understanding exactly how these states interact. Deadline stress is ingrained in many creative industries like animation, visual effects and gaming. These industries could benefit immensely from a better understanding of this complex relationship.

As was stated in the literature, the notion that some stress is beneficial for performance needs critical evaluation and should be rejected in favour of more useful and accurate concepts (Le Fevre et al., 2003). Flow's relationship with creativity is far better understood. If it is the underlying mechanism behind observed increases in creativity due to stress, then perhaps the more accurate concept, yet to be articulated in the research, is that, under the right conditions for flow, deadlines might help to create challenge stressors.

Moreover, research integrating physiological measurements for stress, creativity and flow combined with comprehensive creativity assessment is also limited. This is critical for a holistic understanding of their interplay. Creativity is multi-faceted involving divergent thinking, convergent thinking, domain specific creative practice, personality, etc. This paper may offer some valuable insights for researchers to help formulate new and rigorous, well-designed experiments in the future, based on hypotheses made on the neurological processes behind stress and creativity.

PRIMARY RESEARCH QUESTIONS

Are positive associations sometimes observed between deadline stress and creativity actually indicative of creative flow?

How can better understanding this relationship enhance creativity and artist wellbeing in creative professions that need to work to a deadline?

METHODOLOGY

This research uses a qualitative case study methodology based in Csikszentmihalyi's flow theory (Csikszentmihalyi, 1990) and Lazarus and Folkman's stress theory (Lazarus & Folkman, 1984). It focuses on the idea that challenge stressors, including deadline pressure, can facilitate flow and creativity. The study explores how certain stress conditions influence creativity and flow among animation students working on challenging creative tasks.

Survey Design:

The research included three successive surveys on the same animation students. They participated in two creative projects: "The Unreal Engine Short Film Challenge" (prequel) and "Third Year Major Project" (sequel). Both projects had significant workloads and similar time constraints. Students were more experienced in animation production after completing the first project. The surveys were conducted after both projects had been successfully completed. The surveys employed both Likert-scale (strongly disagree to strongly agree) and open-ended responses to capture quantitative and qualitative data.

Survey questions were structured around three types of creative thinking, informed by a wide range of relevant literature:

1. *Creative Problem-Solving (convergent thinking)*
2. *Creative Ideation (divergent thinking)*
3. *Motivation to Create (cognitive persistence)*

Questions examined the conditions participants felt were necessary for enhancing creativity, such as varying levels of stress, clarity of goals, perceived support, and autonomy.

Survey Validation and Justification:

The surveys' design uses existing psychological research methodologies and was guided by Amabile's (1982, 2018) work on creativity assessment and the consensual assessment technique (CAT). Although the current study relied on self-assessment rather than the full implementation of CAT, this approach has been demonstrated by Amabile to correlate moderately well with expert judgement (Amabile, 2018), lending credibility to the methodological approach.

Likert-scale questions that offer agree/disagree/neutral responses are based on common psychological and creativity research practices, allowing clear quantification and interpretation of subjective experiences and perceptions (Amabile et al., 2002; Baer & Oldham, 2006).

The surveys needed to be carefully balanced so as not to be too demanding. The students were no longer at university, and I wanted to capture as many participants as possible, so I aimed to keep it simple enough to complete quickly, while still capturing pertinent information for my study. By survey three, I had the clearest sense of where my research was leading me, but only five were willing to participate at this late stage.

I explored a broad variety of fields within the academic literature, something accomplished with relative ease in 2024. We now have unprecedented access to information through new technologies. This interdisciplinary, holistic approach has been guided by my experience as a creative practitioner. I have been able to bridge diverse fields that may not have been as aware of each other's unique insights, case studies and research, looking for and finding connections that might help to unravel the complex interplay between stress and creativity. This approach helped formulate the surveys but also convinced me that further research case studies are needed, in a variety of specialist fields, to truly account for everything that I have attempted to capture.

UNREAL ENGINE CASE STUDY

The academic literature has uncovered some interesting insights into my research questions. Would observation of other creatives, animators and visual effects artists support the notion that creativity under deadline stress might have a close relationship with flow? Added support for this theory might encourage quantitative investigation of this delicate interplay in future research, using neuroscience, psychology and observed creative output.

The conditions for flow are comparatively well-understood. Perhaps these conditions are an essential requirement for transforming deadline stress into a challenge stressor which in turn fosters creative flow. Without the precursors for flow, deadline stress might become a hindrance to creativity, but either way this should help in formulating a more accurate understanding of the relationship.

In order to build on our exploration of flow theory as the underlying mechanism for transforming deadline pressure into creativity, we turn to a case study examining these concepts in the lived experience of some of my animation students.

In 2022, a small team of third-year animation students that I was teaching and supervising embarked on two high pressure projects with tight deadlines - The Unreal Engine Short Film Challenge and Third Year Major Project. Both works were highly ambitious due to their extensive scope and tight schedule. In the first project they had little to no experience with real time virtual production, or working as a team. By the second project, they had considerably increased their skill level on both counts.

As supervisor for the team, and also as their animation teacher, I was afforded observational insights and a unique perspective. These projects occurred before I started my research, in fact they helped inspire it. It was a unique opportunity to observe the interplay between deadline pressure, creativity, and flow. After the projects were completed, I followed up with three surveys to investigate more deeply.

I emailed the third-year students to ask their permission for me to research their project and discuss it at the conference as well as in journal articles. Of the 11 students in the team, nine responded and were happy for me to do this, two did not respond. I attempted to contact them several times. To my knowledge they did not participate in the surveys and are not mentioned in this paper.

Both projects were set in an intergalactic space station, the 'Ark', which included alien jungles, aquatic environments, deserts, a myriad of creatures, space craft, docking bays, control centres, and a human crew with robotic assistants. The title of the two-part series was 'Seeking Sanctuary', with the Unreal Engine Short Film Challenge becoming the prequel, and the Major Project the sequel.

The small team comprised some very talented and conscientious third-year students, working together on their first animated production. They were excited to explore real-time animation technology and prepared to take on multiple roles and acquire new skills. None of them possessed prior leadership in animation production.

The Unreal Engine Short Film Challenge started at the mid-year holiday break and overlapped into the third-year Major Project schedule by four weeks. This meant student availability for the Challenge was compromised and both projects had effectively the same schedule of eight weeks.

The project's ambitious scope, combined with the team's inexperience and compressed deadline, made them unlikely to succeed. They eventually recognised this and adjusted their scope accordingly, while still making sure to maintain its appeal for each team member.

Originally, they wanted the Unreal Engine Short Film Challenge to be their Third Year Major Project however the schedule did not align with the university semester, falling in the mid-semester break. The university was happy to allow them to combine the projects but when presented with the choice they collectively decided to keep them separate and go ahead with both.

They then applied for and were awarded financial support by Epic Games for the Unreal Challenge. Scheduling during the mid-semester break resulted in some formidable challenges. There was varying availability of team members due to pre-arranged holidays, family commitments, or work engagements. This resulted in a logistical nightmare for the producer. Additionally, the team needed to learn Unreal Engine and get experienced with motion capture.

Essential personnel were often unavailable at critical stages in production, and I was away in Australia for a month, maintaining minimal communication remotely. The leadership's pragmatic approach helped the team navigate these challenges, but sometimes pivotal decisions were made without properly consulting team members due to availability

and deadline pressure. The finished product, the 'Seeking Sanctuary' prequel, had a coherent narrative but fell short of the team's standards and was marred by rising tensions and notable stress.

As project supervisor, I called a meeting aimed at fostering open dialogue with a focus on constructive feedback rather than finger pointing. The intention was to mend strained relationships. This process prepared them to begin their next endeavour, the Major Project sequel to 'Seeking Sanctuary'.

This time they were better prepared, had enhanced skills and experience, increased confidence and self-belief, and, although the pressures were still there, they handled them much better. There was a feeling of exhaustion for some, however, as they went from one intense project straight into the next. Once completed, the sequel, though less ambitious than initially planned, surpassed the prequel in technical quality, creativity, and educational value. Both projects had similar workloads and the same time constraints. There are obviously other variables impacting the interplay between stress and creativity.

SEEKING SANCTUARY SURVEYS

The Seeking Sanctuary team consisted of 11 students in their third and final year at university. I conducted three surveys; all were done post-graduation. The first two were several months after finishing both projects and the third was over a year later. The surveys are based on self-assessment rather than using physiological measurements for stress or expert judges on creativity, however Teresa Amabile, an expert researcher in creativity at Harvard University, found that self-assessment correlated relatively well with her consensual assessment technique (CAT) which utilises expert judges in the field (Amabile et al., 2018).

SURVEY ONE

This survey was primarily based on my research into the relationship between deadline stress and creativity, eight out of 11 students replied, seven completed the whole survey with one only writing a comment. They were asked a series of questions which they could choose to strongly disagree, disagree, be neutral, agree or strongly agree with. There were three types of creativity, each had the same set of questions. The types of creativity investigated were:

1) creative problem-solving (creative convergent thinking)
2) creative ideation (creative divergent thinking)
3) motivation to create (creative cognitive persistence)

The questions asked about the conditions needed to increase each type of creativity, e.g., Does your '(insert type of creativity here)' increase when…

Under deadline pressure, a little stressed, moderately stressed, significantly stressed, continually under stress, relaxed, in nature, other's trust your ability, you trust your own ability, you are supported, you are challenged, there is a clear goal.

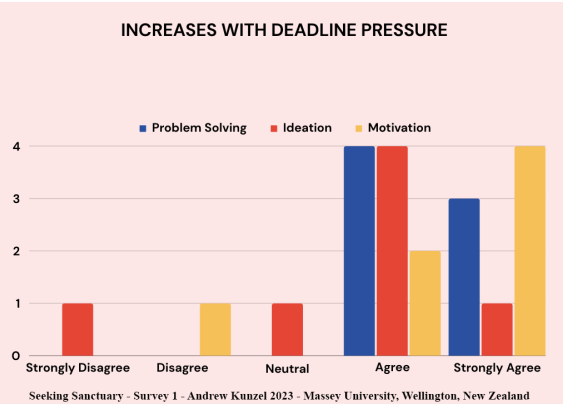

Fig. 1 Creativity and deadline pressure, Andrew Kunzel, 2023

On the question of whether deadline pressure increases creativity, as shown in Fig. 1, most participants agreed that it did, although some thought it detrimental for ideation and motivation.

For the relationship between creativity and low, moderate or high stress, I collated the results into a graph where agree or strongly agree are equal to one, neutral is equal to zero, and strongly disagree and disagree are equal to minus one. I did this to make it easier to visualise the trend, see Fig. 2.

The results show a pattern, but apart from motivation to be creative, the data are closer to an inverted 'J' than the 'U' present in most of the literature. The results suggest that, for most of them, some stress was good, but as it increased it negatively impacted creativity. This could be evidence against the inverted 'U', but before making that conclusion I also thought it might be the way students view the word 'stress'. They are probably not familiar with stress theory and may interpret the word in its general usage as a negative emotional state.

This prompted me to address this stress question a little differently in the third survey, which we will discuss later, by framing it in terms of a challenge stressor: *"If a creative challenge is too easy I find it boring, too hard and it's overwhelming, but if it is just the right amount to push me to do my best, I find it engaging"*. Everyone agreed. This highlights the importance of the 'Goldilocks Zone' where stress is perceived as a challenge and also supports the inverted 'U' relationship.

In terms of long-term stress, the general consensus was that it is detrimental to ideation, but a minority thought it might help problem-solving, and over half felt it motivated creativity, see Fig. 3. Problem-solving and cognitive persistence are more closely linked than the divergent thinking necessary for ideation. It appears that divergent thinking is more severely impaired by long-term stress than convergent problem-solving. This still may have an impact on the level of creativity within convergent problem-solving, remembering that studies have shown that in order to maximise creativity within convergent thinking the brain needs to be primed for divergent thinking first.

Motivation in the survey was presented as a type of persistence to keep on going. Cognitive persistence can be engaged under psychological tension and is an important part of the creative process. This split survey result with half the team disagreeing on motivation, may be indicative of the

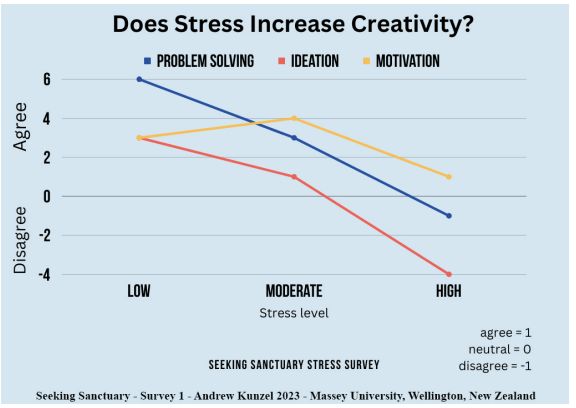

Fig. 2 Creativity and stress, Andrew Kunzel, 2023

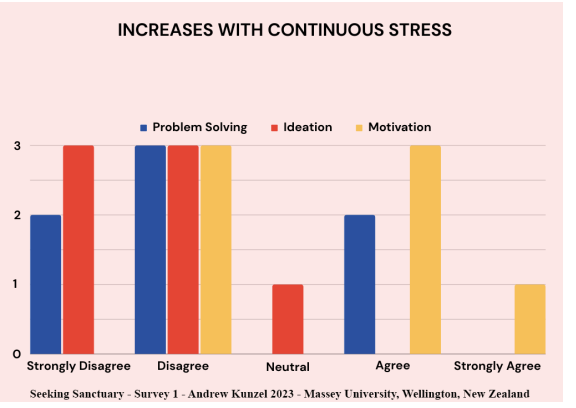

Fig. 3 Creativity and continuous stress, Andrew Kunzel, 2023

varying levels of PsyCap between them as high PsyCap will foster cognitive persistence.

In PsyCap, 'Hope' also refers to a type of cognitive persistence and the willpower to keep on going, knowing you will find a way. People with high levels of hope are particularly adept at finding ways to overcome problems and will be able to turn stress into a positive for creativity for longer than those without as much of this particular psychological resource.

In this paper, we are specifically looking at ways that deadline stress might be able to positively influence creativity, but I came across many studies along the way suggesting that it can thrive under relaxation too. I thought it worth asking the question, as flow and optimal performance are not continually sustainable and could lead to burn out. It may be important to juxtaposition deadline stress with relaxation in production environments.

When asked if relaxation or being in nature increases creativity, see Fig. 4 and Fig. 5, the results strongly supported this for ideation, with mixed findings for problem-solving and motivation. Perhaps divergent thinking thrives in relaxed, non-stressful situations? Earlier in this paper we discussed how stress might facilitate divergent thinking by turning off filters in our executive processing allowing for more spontaneous free association. I suggested this may prime the brain for divergent thinking before the other precursors for flow re-engage convergent thinking, but, having been primed, this convergence is now much more creative via the use of these alternate neural networks. Maybe there are ways this can be achieved without stress?

Mindfulness training has been shown in multiple studies to enhance both divergent as well as convergent thinking (Capurso et al., 2014), as well as a decrease in the default mode network (DMN) (Berkovich-Ohana et al., 2017). It increases scores in fluency and flexibility, with the enhancement of wellbeing (Shen et al., 2021) increasing convergent thinking and emotional regulation. Are these the same neural processes observed in flow, but attained without the need for stressors? This is an area I will be continuing to study for its promising contribution to my research.

Clear goals were seen as incredibly important for most of the team, see Fig. 6, not a surprising finding given the literature, particularly in *Creativity Under the Gun* (Amabile, 2002). Clear goals are also a key condition for fostering flow, which has been well-discussed. Alternate neural systems that are

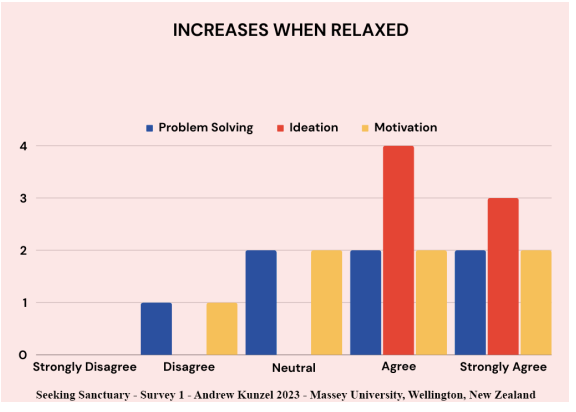

Fig. 4 Creativity when relaxed, Andrew Kunzel, 2023

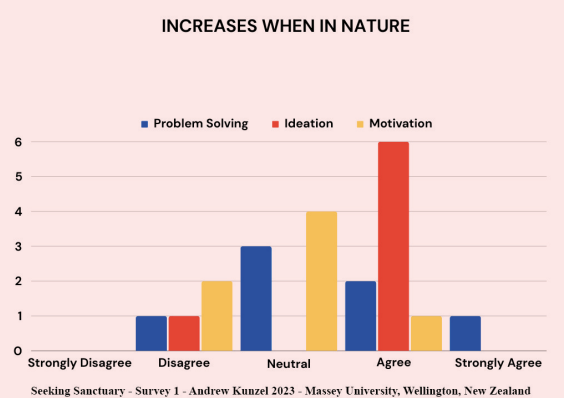

Fig. 5 Creativity in nature, Andrew Kunzel, 2023

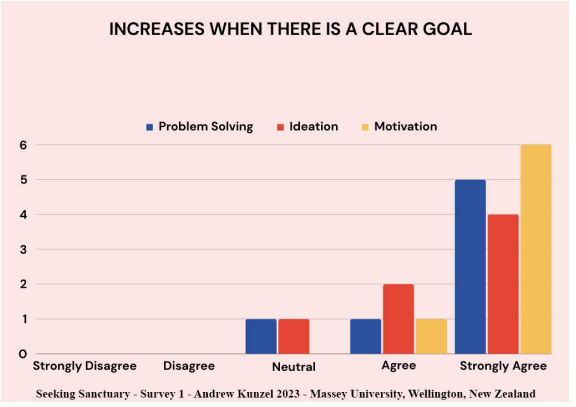

Fig. 6 Creativity and clear goals, Andrew Kunzel, 2023

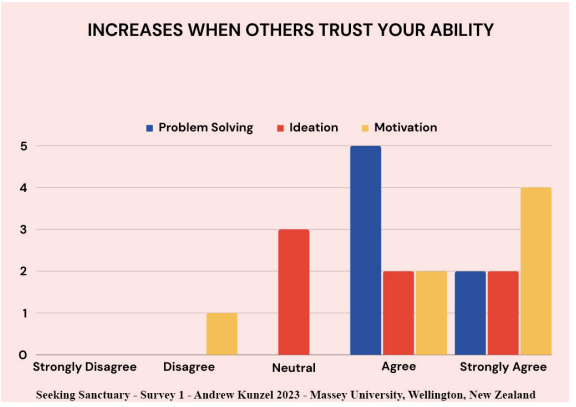

Fig. 7 Creativity and external trust, Andrew Kunzel, 2023

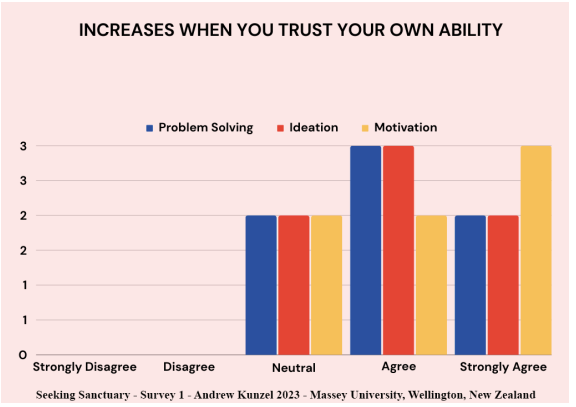

Fig. 8 Creativity and internal trust, Andrew Kunzel, 2023

engaged by stress temporarily shutting down executive filters, may also need clear direction to stay on course. Clear goals have been shown to activate the prefrontal cortex (PFC) as well as help synchronise neural activity in the cerebellum and basal ganglia for seamless performance in flow.

As PsyCap appears to play an important role in moderating stress for creativity, I thought I should ask some questions around support and self-efficacy. Once again creativity was divided into three types, problem-solving, ideation and motivation.

The results in Fig. 9 show that the team felt that being supported leads to increased creativity levels, although it doesn't seem as necessary for ideation. This separation between divergent ideation and convergent problem-solving and cognitive persistence raises its head once again. Here it seems that what other people think of you or whether they support you is less important for divergent ideation, but it is useful for convergent problem-solving or motivation, see Fig 7. Self-efficacy is generally positively correlated, although 28.6% were neutral about this, see Fig 8.

While self-efficacy is important overall, external factors like being supported, others trusting your ability and clear goals

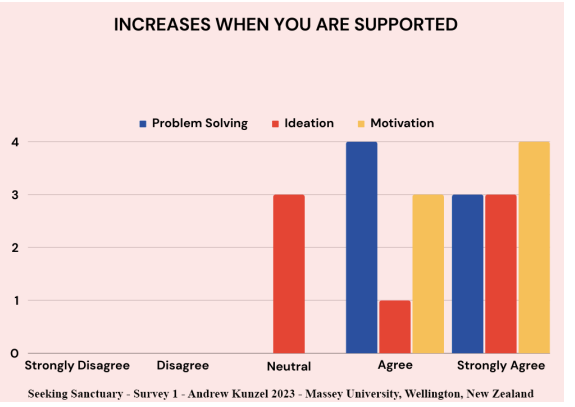

Fig. 9 Creativity and support, Andrew Kunzel, 2023

(goals could be internal or external); were perceived as a significant influence on the team's convergent thinking creativity levels. Research has shown these external conditions affect an individual's level of PsyCap which in turn can foster their ability to be creative under pressure (Simmons et al., 2014). Perhaps this is more important for convergent thinking. Leadership support can also come in the form of positively-framed critiques; something I know the leadership team worked on after the fractures created in the prequel. Constructive feedback and reward for effort can facilitate flow as well as PsyCap.

They were also asked to rate the amount of pressure they felt during the prequel as well as the sequel on a scale of one to five (with one being no pressure to five being maximum pressure). It was interesting to see that the team felt there was little difference between the two, see Fig. 10. To me they had appeared to be more stressed during the prequel (first project) than the sequel (second project).

Perhaps pressure level does not necessarily equate with stress level, especially when you are better equipped to handle it. In survey three, most of the participants agreed, that *'The skills I learned during the prequel increased my ability and confidence, making the sequel feel more like a difficult challenge than overwhelmingly stressful'.* In terms of timeline and the amount of work, the pressure from both projects was very similar. There's also the potential effect of exhaustion in the second project, coming straight after the first. Some agreed that this did have a negative effect on their creativity, but not everyone. Some students also did not participate as much in the prequel due to other commitments, which may have skewed the results here.

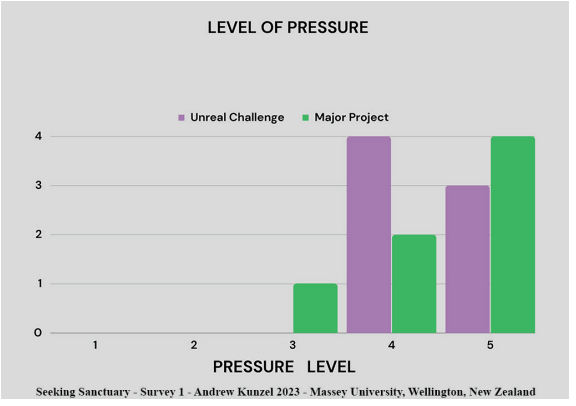

Fig. 10 Prequel vs sequel pressure levels, Andrew Kunzel, 2023

Lastly, they were given the opportunity to comment on any thoughts they might have on the relationship between stress and creativity. They were also asked to indicate their role in the project.

Participant One - Director
The stress and deadline pressure kept the momentum going with both projects and meant creative decisions had to be made quickly. I think the stress helped to keep focus and narrow down options, as well as refine my ideas as we didn't have the space to experiment creatively as much with a deadline. I experienced creative problem-solving under pressure and had some organic and positive results that weren't planned for with being in the moment and trusting my instincts.

Participant Two – Writer
Personally, the more stress I experience the less my creativity is able to flow and the less motivation I have to be creative. I do believe stress can be a good driving force in order to complete work on time; however, extreme stress has only ever diminished my ability to be creative.

Participant Three – Creator, Character TD, Creature Assets
When I find myself faced with a creative challenge that not only involves creating something but also figuring out creative ways of getting the end result you are after, I sometimes find myself getting an almost tunnel vision towards that project.

Participant Four – Lead Assets
I feel that under pressure I can come up with some creative solutions to problems but with too much stress or prolonged stress I can become overwhelmed and burnt out. I do find having a clear goal or deadline does help with focus and allows me to manage my time, so I find this helpful rather than stressful.

Participant Five – Motion Capture
Stress is a great motivator; the greatest creative pursuits have come about from some sort of limitation. Whether that be time, teammates, technical limits in the software or hardware being used... etc. These all contribute minor stress to some degree, the utilisation of that stress can bring about smart decision-making in being more efficient with energy spent completing a task. Stress when managed well is an essential component of the creative process, it can spark the imagination to be innovative and ground-breaking.

Participant Six – VFX
I think having stress can be similar to limitations with creativity in that it can make you more productive as you have less time/options and so on. I think our project was a little too ambitious, so it was a very stressful period, and I appreciate Andrew getting the scope down to the size it was- and overall am very happy about the outcome.

Participant Seven – Lead Animator
I think in terms of problem-solving; more stress (as much as one could handle) would lead to more creative problem-solving, "I have to get this done, so I'm open to how" kind of mentality, little workarounds, shortcuts or completely different workflows that we wouldn't have thought of at the start.

In terms of idea generation - I feel there's a sweet spot when it comes to stress, at least for me. Too stressed and I would shut off and focus on the simplest idea and just how to get there. Not stressed enough, I wouldn't feel that budge to come up with something decent at all. Preparation and having a clear goal set beforehand makes this easier - since now all your focus (and stress) is on the execution.

Participant Eight – Lead TD/Shaders
I believe pressure can be massively helpful, but only for very limited periods of time, like deadline pressure. Continuous stress just leads to burn out, and no one is creative then.

The comments support the complexities inherent in the relationship between stress and creativity, including variation between individual personalities but there are some common themes. Some stress appears to be positive for creativity, too much is bad, clear goals are helpful, there are also indicators for flow and stress leading to divergent thinking: "more stress (as much as one could handle) would lead to more creative problem-solving, 'I have to get this done', so 'I'm open to how' kind of mentality, little workarounds, shortcuts or completely different workflows that we wouldn't have thought of at the start" (Participant Seven) as well as convergent thinking, "stress helped to keep focus and narrow down options, as well as refine my ideas as we didn't have the space to experiment creatively as much with a deadline" (Participant One). Overall though, the comments fall heavily on the side of creative problem-solving. Even the comment I used as an example of divergent thinking was prefaced by "I think in terms of problem-solving; more stress (as much as one could handle) would lead to more creative problem-solving" (Participant Seven). Could this be evidence for stress priming for divergence so that when it re-engages with convergence, the solutions are more creative? Is sustaining divergent creativity more difficult than convergent creativity as stress increases? This highlights the importance of further research into the psychology and neuroscience when investigating the relationship between stress, creativity and flow.

SURVEY TWO

As I continued my research into stress and creativity, I saw more and more correlations with flow state and wanted to ask the students about their thoughts on this. I was aware that they were no longer at university and had already been kind enough to engage in my previous survey. To maximise participation, I chose not to overload the students with too many questions. Instead, I asked just one, using the same strongly disagree to strongly agree scale as the previous survey. Seven out of the 11 students on the team responded.

Question:

Please indicate your response to the following statement (from strongly disagree to strongly agree):

The focus required to meet a deadline can induce a flow state *(get you in the zone)* when the task is highly creative and you're up for the challenge *(as opposed to mundane or less creative tasks or creative tasks you feel are beyond your skill sets)*.

I also included these definitions for the terms 'flow' and 'creative tasks' within the survey:

1) Flow, also known as being "in the zone," is a mental state in which a person is fully immersed in a feeling of energised focus, full involvement, and enjoyment in the process of an activity. It's a state of optimal performance and engagement where individuals often lose track of time and feel a deep sense of satisfaction.
2) A "creative task" is a task or activity that requires individuals to engage in original thinking, problem-solving, or idea generation to produce something new, novel, or innovative. Creative tasks often involve breaking away from conventional or routine approaches and encouraging individuals to explore new possibilities and perspectives.

Out of the 11 team members, seven participated in this second survey and six strongly agreed and one agreed. This significantly supports the relationship that precursors for flow have in positively fostering creativity under deadline stress. Perhaps it may help to clarify a better understanding of what is really going on. Researchers have suggested that the notion that some stress is beneficial for performance needs critical evaluation and should be rejected in favour of more useful and accurate concepts (Le Fevre et al., 2003). Flow appears to be a more accurate determinant of creativity than deadline stress. Perhaps we should reframe the concept in terms of deadlines having the potential to create a challenge under conditions for flow.

SURVEY THREE

The further I delved into my research the more questions I had. Even though over a year had passed since the Seeking Sanctuary projects had been completed, and the students had left university and moved on, I thought I would try another survey and see if anyone responded. I kept to the Likert-scale format. I asked people who had little or no involvement in the prequel to answer with 'neutral' if they felt unqualified to answer. The survey was completely anonymous. This time, five out of the 11 participants responded. Below is a list of the statements presented to them and a summary of their responses:

1) *When creative stress feels like an exciting challenge and is not overwhelming, my mind opens to more ideas than it would in everyday life.*

   All five participants agreed. This supports the idea that if a challenge stressor is intrinsically rewarding it will foster creative divergent thinking. Potentially this is also evidence for stress deactivating executive processing filters and engaging with alternate neural networks to prime the brain for flow.

2) Flow state is often triggered by a challenging task that I find intrinsically engaging.

   Four participants agreed, one was neutral. This is very similar to statement one where everyone agreed; however, it supports an intrinsic challenge fostering flow rather than just fostering divergent thinking. This question also did not qualify the challenge as not being 'overwhelming', which could have altered their perception of what a challenge is. Support is still relatively strong for this.

3) *If a creative challenge is too easy, I find it boring, too hard and it's overwhelming, but if it is just the right amount to push me to do my best, I find it engaging.*

   All five participants agreed. This represents the curvilinear relationship that creative flow has with stress. If stress is seen as a challenge, matching an individual's skill level, then it becomes engaging.

4) I use creative thinking to help me resolve some of the tensions I feel between the way things are and how I would like them to be.

   Four participants agreed, one was neutral. There are theories that suggest creativity is deeply rooted in our biological evolution as a subconscious process that helps us to resolve psychological discomfort. Under creative flow, alternate neural networks are engaged and there is a decoupling with the default mode network. Some of these alternate networks are deeply subconscious and could point to deeper more primal process for creativity. It is interesting that agreement was strong for this more speculative concept.

   It was important for me to discover if my subjective observations about the differences between the prequel and sequel would be reinforced or rejected by the team. I suspected that the students felt more moments of flow and creativity in the sequel and that is why it was a better creative product than the prequel. I felt that this happened for several reasons.

   A deeper level of understanding of motion capture and Unreal Engine 5, as well as the acquisition of many other new skills, bolstered their confidence, allowing them to focus on quality and a clear vision for a more satisfying goal.

   Mutual understanding and improved communication appeared to impact positively on team morale in the sequel. The team leaders, pragmatic, and now better organised, appeared to ensure artists had access to clear feedback, clear goals and the necessary resources to foster a healthy, collaborative, and more effective environment. These are conditions that can foster flow, particularly clear goals and feedback, but also means efficacy, supportive leadership and measures to broaden and build psychological capital.

   There are many variables that can influence one's perception of a challenge stressor versus a hindrance stressor, and managing those variables to establish the right balance for flow can be difficult. Tailoring a production with enough flexibility to find tasks that match an individual's unique skill level, or what they find intrinsically engaging, or their level of PsyCap, or motivation, etc., is complex and certainly nuanced. The team were able to strategise more effectively around this for the sequel, by opting to create a teaser trailer instead of a short film. This reduced the length of the work as well as allowing for new levels of creative storytelling with a freer structure. An effective mechanism for achieving the right balance for reaching and maintaining the 'Goldilocks Zone', offering greater flexibility to dial back the stress if challenges started to become overwhelming.

It was with all of these things in mind that I formulated this last set of questions in survey three:

5) I felt more moments of flow, being in the zone, during production of the sequel.

   Four participants agreed, one was neutral. This was a high level of direct support for my personal observation that flow was more likely to be higher in the sequel because the conditions for flow were much higher.

6) The sequel was a better creative product than the prequel.
   Four participants agreed, one was neutral. Once again this is good support for the sequel having better conditions for creativity than the prequel even though the pressure and deadlines were similar. It suggests something had changed within the team, like skill level, PsyCap, culture, and flexibility, etc.
7) I felt more creative during production of the sequel.
   Three participants agreed, two were neutral. It's interesting that support for feeling more creative is not as strong as support for the sequel being more creative, although nobody disagrees. This could be because a survey participant may have been less involved in the sequel, or maybe it was the exhaustion from back-to-back high-pressure projects, or maybe it was none of these. I would need to dig deeper to find answers.
8) The exhaustion from working on the projects back-to-back negatively affected my creativity in the sequel.
   Two participants agreed, two were neutral, one disagreed. Exhaustion was a factor for some, but not everyone. The person who disagreed must have been heavily involved in both projects otherwise they would have indicated a neutral response. As only five out of 11 participated in this survey, it's hard to determine if exhaustion was a big factor for the team.
9) The skills I learned during the prequel increased my ability and confidence, making the sequel feel more like a difficult challenge than overwhelmingly stressful.
   Four participants agreed, one was neutral. A marked increase in skills, thanks to working in the prequel, really did bolster confidence and support conditions for flow. Perceiving stress as a challenge rather than a hindrance is critical in flow theory.
10) The sequel was a more positive experience for team relationships than the prequel.
   Three participants agreed, one was neutral, one disagreed. This question was partially aimed at the team leadership, as I believed they had improved their approach and had created a more supportive environment in the sequel. I felt that this question also supported the notion of broaden and build and increased PsyCap in the sequel, both from getting support as well as feeling generally more confident and positive about outcomes. While there is mostly agreement in the survey, somebody did disagree. This could be evidence against feeling supported or it could be evidence against feeling any more supported. I would have needed to formulate a better question to get to the bottom of this.
11) I felt more supported by the team in the sequel.
   Two participants agreed, two were neutral, one disagreed. This is very similar to the previous question but asks specifically about the individual's feeling of being supported, rather than a more general positive experience. The results are too varied to be able to generalise. Some felt more support, but some didn't. I feel that even though you could read a 'disagree' as the prequel and sequel having the same level of support, there were tensions between the team after the prequel. While most appeared to have been resolved, perhaps a few tensions lingered. I would have liked to dig a little deeper.

So far, the surveys, comments as well as my observations during the Seeking Sanctuary productions, generally support the idea that deadline stress will more likely foster creativity when the conditions for flow state are also present. They also bolster my theory that these conditions were more evident in the sequel and that is why it was both a better creative product and a more enjoyable production experience. Both the students and I agree that the sequel is creatively superior to the prequel but perhaps there's a better, more objective assessment technique that we could use.

Amabile, who has been researching creativity extensively for many years, suggests in *Creativity in Context* (1996) that it can be difficult for people to accurately self-assess their creativity levels: "it would be impossible to assess interjudge

reliability. This would effectively render such a measure invalid" (Amabile et al., 2018, p. 73). However, in subsequent studies, Amabile and colleagues "found that self-assessments correlate moderately positively (in the range of .30 to .40) with mean judge assessments" (Amabile et al., 2018, p. 73).

This led her to introduce a new method for measuring creativity, referred to as Consensual Assessment Technique (CAT) and was first introduced in her seminal paper "Social psychology of creativity: A consensual assessment technique," published in the *Journal of Personality and Social Psychology* in 1982. It relies on the subjective assessments of a panel of expert judges. These experts are usually professionals or individuals with extensive experience in the relevant field, and their role is crucial in the evaluation process.

I did not have the opportunity to meet the exact requirements of the CAT, but both Seeking Sanctuary films were assessed by an expert panel of lecturers from animation, film, television, games and immersive technologies. I also presented this paper at the CAPA Animation Conference 2023 where I screened both films. The general consensus among the university assessment panel and conference researchers and industry professionals, was that the Seeking Sanctuary Major Project sequel was a much more successful creative product than the Unreal Engine Challenge prequel.

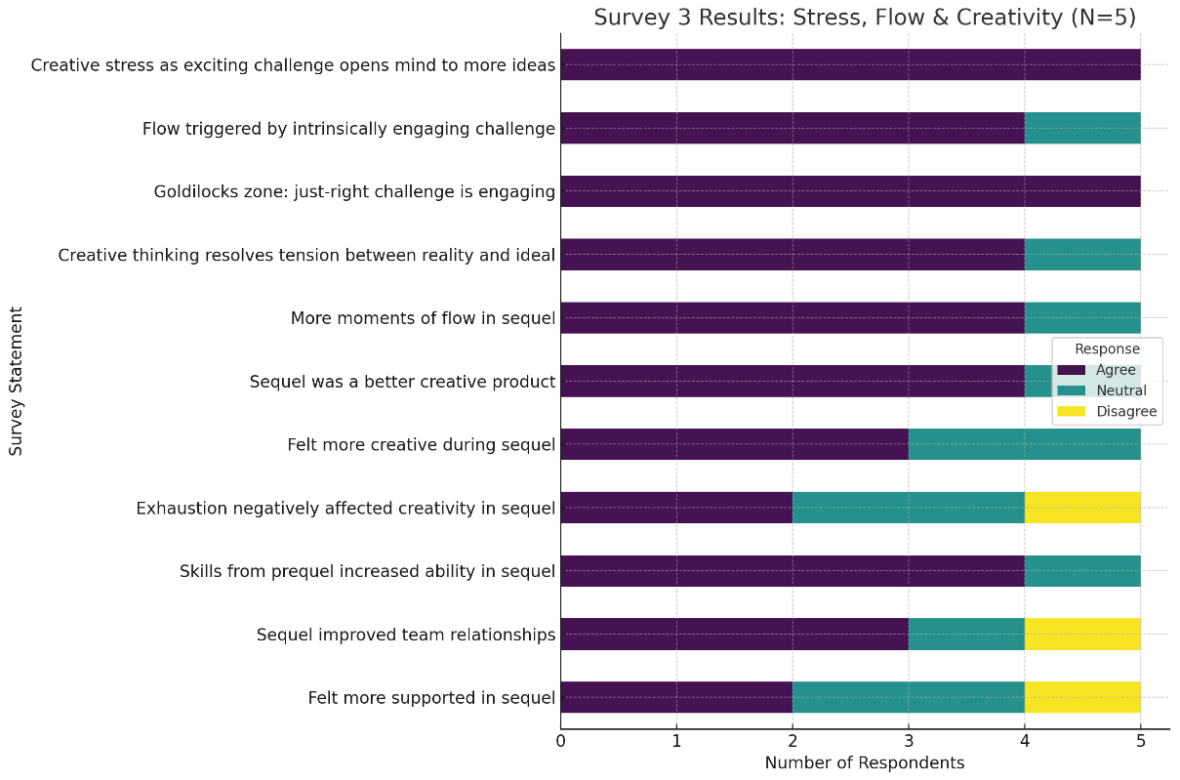

Fig. 11 Survey three results, Andrew Kunzel, 2023

SCOPE AND LIMITATIONS

The case study aligns well with the hypothesis that flow may be the underlying mechanism behind observed increases in creativity under deadline pressure. It does have its limitations, however. The team was small, only 11 people, and the surveys did not capture everyone's feedback, so the results, while qualitatively compelling are not statistically significant.

The case study was not *designed* as part of my research, but rather my research developed because of what I had observed. This meant there were variables between the two projects that may have impacted the findings, particularly around team availability, and this may have skewed results. If the case study had been designed to look for answers to my research questions, I would have tried to eliminate the variables I was not testing for.

It's also important to note that while my personal and professional insights have helped to guide me, they are balanced with empirical evidence from the literature and qualitative findings from my case study. Evidence against an intuitive lead is just as useful as evidence supporting it. I have changed my initial perspectives on stress and creativity. Stress does appear to play a more significant and interesting role than I originally was prepared to believe, to prime neural networks for divergent thinking, as well as regulating balance between top-down executive processing and sensory-vigilance in flow via the prefrontal cortex.

CONCLUSION

This study supports the notion that flow is integral in turning deadline stress into a positive for creativity. The belief that moderate deadline stress will, in and of itself, enhance creative productivity is inaccurate and limited. The evidence is mixed and the terms are subjective, what might be moderate stress for one artist, could be an anxious nightmare for another, or even a boring slog. This phenomenon should be framed in terms of flow rather than stress, e.g., '*when the conditions that facilitate flow state are present, deadline pressure may transform a task into a challenge, therefore triggering flow and increasing creativity*'.

The practical application of these findings could enhance creative output in high pressure environments, like animation and visual effects; by increasing creativity, productivity as well as artist wellbeing. Work in these industries can be subject to long hours and high stress. While the research into stress and creativity is complex, nuanced and often ambiguous, the conditions for flow are relatively well-understood.

Creating environments that support the PsyCap or psychological resources of professional creatives as well as integrating strategies to tailor challenges and rewards for the individual artist, might open up the potential to dial in optimal performance, or flow, as needed. This increased level of creative productivity, accompanied by the intrinsic enjoyment of being in flow might enable workers to meet deadlines without the negative effects of anxiety and extended working hours. This would be a positive step forward for artist wellbeing, work culture and productivity.

One of the difficulties of implementing these findings in the workplace is how do you tailor challenges for individual artists, how can this be managed? In Seeking Sanctuary, we saw how this could be done via task flexibility, creating a trailer, but this is not always possible. There is a lot of research into how to keep players in flow while playing games and some of these ideas might be transferable into the workplace. I have been experimenting with using mini-deadlines in class along with conditions to support flow in my teaching and am getting some good results. This area needs further research. There may also be potential negative outcomes with using flow in the workplace.

Alternate neural networks that keep people in constant flow are sometimes implicated in unhealthy addiction and burn out. This has been particularly evident in the gaming industry, both in relation to computer games and gambling, where the neurological processes underpinning flow are capitalised to keep people engaged. Using flow as a managerial tool may therefore hold similar dangers. Perhaps it should be used intermittently, combined with times of relaxed exploration and mindfulness which have also been shown to boost creativity. Creativity is multifaceted, it goes well beyond flow and deadline pressure, and more research is needed if we want to successfully implement the findings of this paper into a professional work setting.

Interdisciplinary collaboration between researchers, practitioners and creatives might provide the opportunity to dive deeper into this subject; further study is certainly needed, along with open dialogue and a curious mind. Learning how the brain harnesses the power of a conscious and subconscious in harmony when in flow offers promising insights not only into creativity but the broader spectrum of cognition, its capacity to innovate, problem solve and find resilience in the face of challenge.

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