SPORT SPARKS: Supporting Creative Thinking by Professional Coaches

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Abstract: This short paper reports a new digital tool that supports creative idea generation about possible solutions to these challenges. Exploratory design research resulted in a new digital tool that was designed for use by the coaches of elite athletes, to discover creative ideas with which to remove, overcome and mitigate the effects of concrete athlete under-performance. Furthermore, initial feedback from 22 professional sports practitioners revealed that use of the tool led to most of them understanding the challenge from new perspectives, exploring alternative options to solve the challenge, and influenced their decision-making about the challenge.

1 STRUCTURED CREATIVE THINKING IN ELITE SPORTS

Coaching elite athletes often requires these coaches to solve complex coaching problems. Examples of these coaching problems include overcoming recurring injuries, motivating athletes, and maximizing their performance at the right time. Solving these problems is rarely perceived to involve creative thinking, even though many of these problems might be perceived to be wicked and ill-structured, and benefiting from creative thinking.

Creativity has been the subject of extensive research. It can be defined as the ability to produce work that is novel and original, as well as appropriate and useful (Sternberg 1999). According to Maher & Fisher (2011, p46), most definitions of creativity include novelty as a criterion in creativity assessment, often expressed as a new description or new value of an outcome. Kaufman & Beghetto (2009) define 4 different forms of novelty that distinguish between big-C creativity that is an eminent contribution to society, and little-c creativity that is an everyday but novel outcome not often perceived to be creative in society. Opportunities for big-C creative outcomes in sports coaching are few. One example might be the members of a professional football team sitting down to write a book together, as undertaken by Swedish team Östersund. Opportunities for little-c outcomes in elite coaching are much more common. These outcomes might be novel to the elite athlete and coaches who generate them, but perhaps not to others. Reported examples of little-c coaching outcomes include changing an athlete's home diet, replaying set-piece training on large screens next to the pitch, and using different clothing when training. In this paper we argue that reframing some elite athlete coaching as everyday creative thinking to generate little-c outcomes has the potential to solve athlete challenges more effectively, and as a consequence, contribute to athlete performance.

Numerous structured creative thinking processes and techniques are now available to guide individuals and teams to generate little-c creative outcomes. Many of these processes and techniques can be traced back to the new creative solving processes reported by Osborn (1953) and Green (1960). During the 1960s and 1970s leaders such as Edward De Bono (2007) developed lateral thinking and Genrich Altshuller evolved the TRIZ method for structured creative problem solving (Altshuller 1999). These foundations have resulted in a large number of structured creative thinking techniques that can be applied to solve problems. However, so far, there have been few reports of uses of these techniques to coach elite athletes. One of the exceptions was the rollout of CPS, a structured creative thinking process and techniques (Isaksen et al. 2011) for use by strength-and-conditioning coaches at the English Institute of Sport, after the Rio 2016 Olympic Games. Up to 45 coaches were trained to use it to resolve day-

to-day coaching challenges. However, published data about the effectiveness of the rollout is still lacking.

What is more, there have been no reports of digital creativity support tools being used to coach elite athletes. Digital creativity support tools are a breed of tool that help people engage more creatively with the world. People use them to, e.g., discover new content, synthesize novel content from existing material, or direct their thinking to generate new ideas. Most reports of successful uses of these tools are in creative industries such as broadcasting (Bartingdale et al. 2013), theatre (Schofield et al. 2013) and journalism (Maiden et al. 2020). A smaller number have been reported in other industries, e.g., manufacturing (Maiden et al. 2019), but none in professional sports.

Therefore, this paper reports exploratory design research to evaluate a new digital creativity support tool called *Sport Sparks* to support elite coaches.

2 RELATED WORK

This section reports related work on creative thinking in sports and digital creativity support tools.

2.1 Creative Thinking in Elite Sports

The need for creativity in elite athlete performance has been established. For example, increased team creativity was associated with goal scoring and progressing to later rounds of elite football tournaments (Kempf & Memmert 2018), and developing more creative coaches and players was central to a vision for the future of English football (Football Association 2013). Some research has sought to foster the creative capabilities in athletes. For example, Memmert (2007) proposed method principles for tactical creativity approaches for team sports – principles such as *deliberate practice*, *deliberate memory* and *diversification*. He argued for the use of these method principles to train divergent thinking abilities, tactical creativity and creative thinking to children and young people who were engaged in sports (Memmert 2015). Evidence of the effectiveness of the use of these principles in studies revealed that, e.g., training in attention-broadening techniques over 6 months facilitated greater improvements in creative performance in complex team sports tasks than in simple tasks (Memmert 2007) In a similar vein, Ludvig et al. (2019) conceptualized creativity as a developmental resource in sport training activities. Creativity was framed as the exploratory and playful processes of discovering, exploiting, and originating unusual action possibilities, which led the authors to argue for the stimulation of creative actions during training.

Some attempts to introduce creative thinking into coaching methods have been reported. One exception was the UK Sport's search for novel ideas to have a positive impact on medals for the Great Britain and Northern Ireland team at the 2012 Olympic/ Paralympic Games (Hunter 2010). The adoption of creative thinking methods based on rapid trial-and-error of ideas was effective, even though it conflicted with the established values of evidence-based science from clinical practices that underpinned elite sports coaching. Nonetheless, the UK teams finished high in the two medals tables, suggesting a possible effect from the use of these methods. However, there are few other reports of the systematic use of creative thinking techniques, skills or digital tools by elite athlete coaches to resolve the problems that these athletes encounter in more novel and useful ways.

2.2 Digital Creativity Support Tools

Digital creativity support tools have been the subject of research and development for 30 years, and have been applied in different forms to diverse artistic, scientific and professional domains. Most of these tools have been interactive, and combine automated reasoning capabilities with new forms of interaction (e.g., *visualizations*) to help people engage more creatively with activities. One early system was *Dynamic HomeFinder*, a prototype for real-estate agents that used dynamic queries that allow users to adjust the cost, number of bedrooms, and locations to explore available house locations on a map more creatively than with traditional queries (Williamson & Shneiderman 1992). *CombinFormation* was a mixed-initiative system that integrated searching, browsing and exploring information, was developed to support exploratory and combinational creativity with information retrieved by Internet search engines (Kerne et al. 2008). *TweetBubble* was a browser extension to Twitter that enabled the expansion of social media associations in usernames and hash-tags in-context, and supported exploratory browsing on top of metadata type system with new presentation semantics (Jain et al. 2015). Some of the tools were developed to support creative thinking in science and engineering, e.g., new tabletop visualizations to support biological discoveries (Wu et al. 2011) and social media to support collaborative creativity in education (Aragon et al. 2009).

Moreover, the development of digital tools to support the creative thinking of people in professional roles has been growing. Some have been implemented for

use by professionals in the creative industries, from the performing arts and music to film, television and journalism. Examples include *StoryCrate*, a collaborative editing tool developed to drive users' creative workflows within a location-based television production environment (Bartingdale et al. 2013), *Trigger Shift*, which appropriated information technologies into performance art in theatre (Honauer & Hornecker 2015) and *INJECT*, which supported journalists to discover new angles on news stories (Maiden et al. 2018). Digital tools have also been developed to support collaborative creative tasks during early design ideas (e.g., Andolina et al. 2017, Schnädelbach et al. 2016). Other tools included *Risk Hunting*, which supported creative thinking to resolve health-and-safety risks in manufacturing (Maiden et al. 2017), and *Carer*, a smartphone app that supported professional care workers to think creatively about how to manage the challenging behaviours of older people with dementia (Zachos et al. 2013). However, in spite of the range of tools and positive lessons learned from their application, the researchers were unaware of direct applications in professional sports.

Research in the sport sciences has developed new analytic capabilities based on the collection of large datasets using, e.g., invasive and tracking sensor technologies. Examples applied to elite athlete coaching included force-time curve analysis of athletic movements such as countermovement jumps, isometric joint position holds and sidestep changes of direction (Millett et al. 2018), and GPS tracking of athletes in training and competition to profile running intensities, accelerations and decelerations. Although numerous algorithms to support sense making from this data have been developed (e.g., De Silva et al. 2018), few of them support explicit creative thinking have been reported. One exception is self-tracking data as art to offer an alternative view on the concept of the quantified self (O'Neil 2019), and builds on a four-stage model of artistic creativity (Mace and Ward 2019) that was demonstrated using artworks constructed from self-data during cycling.

To conclude, this review revealed only occasional uses of structured creative thinking in elite sports, and none applied to support the problem solving by coaches of elite athletes. Furthermore, no previous uses of digital creativity support tools in elite athlete coaching have been reported, to use the large datasets now available in the sector. Research can introduce new forms of systematic creative thinking into elite athlete coaching for the first time.

3 CO-DESIGN METHOD

A collaborative co-design method was used to introduce new forms of systematic creative thinking into elite athlete coaching. Researchers worked with a national sports body that was seeking to empower its strength-and-conditioning coaches of elite athletes with new form of digital support that leveraged its expertise and digital resources. The focus of this digital support was strength-and-conditioning, i.e., the physical and physiological development of athletes for elite sport performance, for use by less-experienced strength-and-conditioning coaches, most of whom were recent graduates in sports science.

3.1 Creative Thinking Techniques

The researchers engaged strength-and-conditioning coaches in some simple activities to understand the scope and nature of creative problem solving about athlete challenges. The researchers explored the extent to which existing creative thinking techniques could contribute to resolving athlete challenges. In one exercise, the coaches explored the potential of creative thinking heuristics extracted from the *TRIZ* method (Altshuller 1999), and presented on a deck of cards. Examples of these heuristics included *evening out different forces*, and *making things more flexible*. After being invited to select cards that had the potential to stimulate creative ideas for athlete strength-and-conditioning, the coaches agreed a set of 63 heuristics. The heuristics were also codified for manipulation by the *Sport Sparks* prototype's algorithms to generate directed guidance for coaches.

3.2 Expert Knowledge

The researchers ran a workshop with two of the most senior strength-and-conditioning coaches, each with over a decade of experience of coaching elite athletes, to surface meta-processing knowledge used to discover ideas to resolve strength-and-conditioning challenges. The *SCAMPER* creative thinking technique (Michalko 2006) was used to surface the coaches' wide-ranging practices for resolving athlete challenges. A post-workshop analysis by the researchers of all of the reported practices then led to the development of the *fishbone* diagram depicted graphically on the right of Figure 1. The diagram depicts different causes extending to the left from the athlete challenge as fishbones, with ribs branching off the backbone for major causes, with sub-branches for root-causes. It revealed that many of the contributing

types of cause for non-optimal performance in training and competitions were not directly sports-related. These cause types related to the personal motivations of the athlete (e.g., *income to provide for family over competition success*), the coaching environment (e.g., *personality differences with the coach or other team members*), home life (e.g., *life styles and priorities*) and locations of competitions (e.g., *preferred climates, cultures and distances to travel*). These types were used to frame and select different types of creative guidance manipulated by the *Sport Sparks* prototype's algorithms.

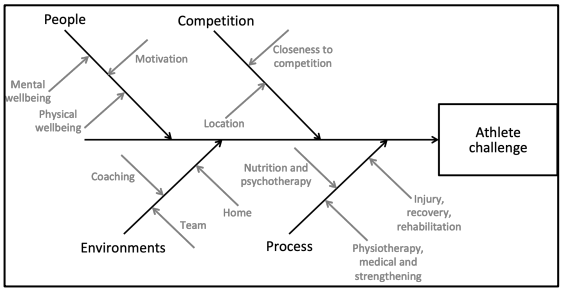

Figure 1: Different cause types for elite athlete challenges identified by senior strength-and-conditioning coaches.

This analysis also led to a consolidated set of practices reported to be effective for resolving athletes' problems. Using data from the workshops, the researchers associated these practices to the cause types described in the fishbone diagram. Practices associated to the personal motivation of the athlete included *assessing the emotional state of the athlete*, and practices associated to the team environment included *considering relevance of the athlete's personal values*. These practices were also codified in the *Sport Sparks* prototype algorithms.

3.3 A User-Centred Design Process

A user-centred design of the *Sport Sparks* prototype took place with the less-experienced coaches from the national sports body. These coaches trained international athletes in sports such as rugby, field hockey and rowing. After interviews with the coaches to understand their work processes and uses of existing digital tools, a decision was made to implement *Sport Sparks* as a responsive web application for use on the different types of desktop computer, tablet and smartphone used by the coaches. Subsequent design tasks were concentrated into a series of workshops. The first workshops demonstrated existing digital creativity support tools developed for other domains and allowed the coaches to experiment with different structured but paper-based creativity techniques such as *constraint removal* and *TRIZ* (Altshuller 1999). Feedback on the potential value of and preferences for each technique and tool was then interpreted to design a first *Sport Sparks* prototype. During subsequent workshops, the research team presented more complete and robust versions of the prototype. Key changes made between the workshops included tighter integration with the causal analysis technique, better language processing algorithms to generate more natural more readable text outputs, and incremental refinements of the algorithms that generated candidate creative ideas.

Once a robust and usable version of *Sport Sparks* had been implemented, it was hosted online and made available with user help and a discussion forum to the same strength-and-conditioning coaches. This result is described in the next section.

4 FIRST VERSION OF THE *SPORT SPARKS* PROTOTYPE

A first version of the *Sport Sparks* prototype was built to assist less-experienced strength-and-conditioning coaches to solve problems experienced by athletes. The prototype was designed so that an individual coach would interact with it in 4 steps, and could return to previous steps at any time. The steps were: 1) *describe the athlete's challenge*; 2) *explore ideas about the challenge*; 3) *re-explore your ideas*, and; 4) *generate the ideas guide* to take forward. In this section each interaction is demonstrated using an example of a field hockey player struggling to maintain fitness levels through an 80-minute match.

4.1 Describing the Athlete's Challenge

Sport Sparks was designed so that the coach could describe each challenge using natural language phrases and one challenge type selected from a set of predefined types. This type was required for *Sport Sparks* to generate creative guidance specific to the entered challenge. In our example, the page for describing the athlete's challenge is depicted in Figure 2. The coach enters the challenge *the hockey player struggles to maintain fitness throughout the match*, tags it with the challenge type *physical wellbeing*, then explores the generated guidance defined by clicking the *EXPLORE NEW IDEAS* button to the right of the challenge.

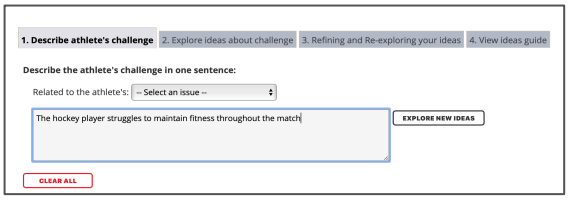

Figure 2: Describing the athlete's challenge using the *Sport Sparks* prototype

4.2 Exploring Ideas about Challenges and Possible Solutions

In response *Sport Sparks* algorithms generate candidate ideas with which to overcome, avoid or mitigate the effects of the challenge, based on the entered description and selected type. The prototype generates 5 ideas about actors, objects and activities extracted from the challenge description, another 5 ideas about possible solutions to the challenge, and 3 constraints to open up the space of possible ideas. Examples of these ideas and constraints are shown in Figure 3. Generated ideas and constraints were presented as natural language sentences that were easier to read, compared to graphical representations. The presentation of each candidate idea was designed to encourage the coach to think more creatively about the described actors (e.g., *the hockey player*), objects (e.g., *stamina*) or activities (e.g., *completing the game*). Example ideas related to the example challenge included *Think about the athlete's culture and background impact on the diet*. Example ideas about possible solutions include *Think about the impact of balancing the diet with something else*. Generated constraints included *Consider the analysis software. Imagine that it is not a constraint. What other ideas for training would be possible?* Space in this short paper precludes algorithm definition.

At any time, the coach could mark each idea or constraint for further use by clicking on the light bulb next to the idea – each remained lit until the light bulb was clicked again. She can also add new ideas of her own using freeform textboxes. After the coach has selected enough ideas and constraints to consider in more depth, she could progress to the third step, to re-explore the ideas.

4.3 Reexploring Generated Ideas

During this step, *Sport Sparks* encourages the coach to explore selected ideas from alternative perspectives, to encourage more creative ideation. The *select alternative perspective* pulldown menu encourages the coach to explore each selected idea one idea that can solve a different type of challenge. The coach could, for example, reframe the selected idea *Revise the training schedule to allow more warm-up and preparation time before matches* from the perspectives of *nutrition* or *location*, then click the *EXPLORE THIS PERSPECTIVE* button to generate further ideas based on new type is shown in Figure 4.

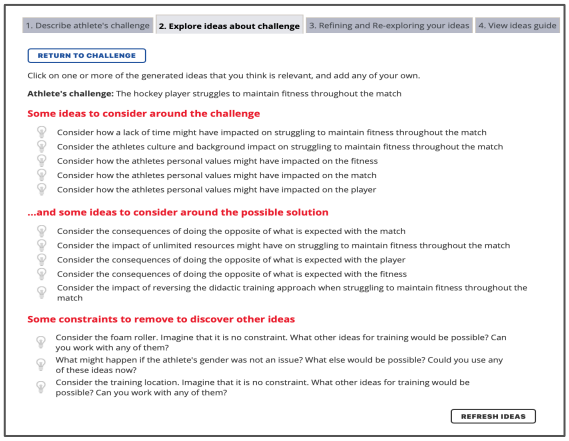

Figure 3: Use of the *Sport Sparks* prototype to explore candidate ideas to solve the hockey player's challenge

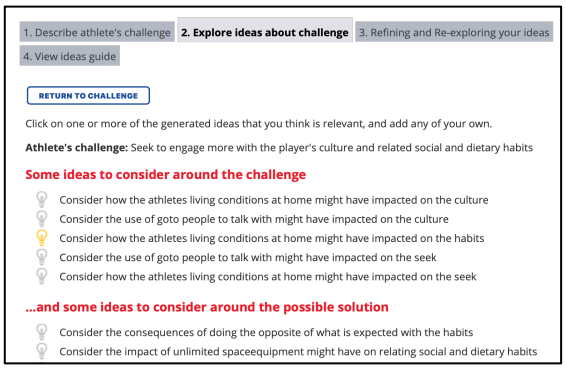

Figure 4: Re-exploring generated ideas from a different perspective using the *Sport Sparks* prototype

4.4 Viewing the Ideas Guide

At the end of each session, *Sport Sparks* allowed the coach to print a meeting guide as a PDF document.

5. A FIRST EVALUATION

To elicit first formative feedback, the described *Sport Sparks* prototype was made available to professional sports practitioners who were working with elite athletes. Each was sent the link to *Sport Spark* web application, a second link to a website describing the purpose of the prototype, and requested to use the

prototype to solve challenges that one or their athletes might be facing. During this period, the researchers provided no hands-on support to the practitioners.

A total of 22 professional sports practitioners each used the *Sport Sparks* prototype to seek to resolve at least one athlete challenge. The practitioners were responsible for strength-and-conditioning in diverse sports – football, skiing, athletics, rowing, rugby and lawn tennis – as well as across combinations of these and other sports. They were employed in different types of organizations, from national sports bodies and universities to Premier League football clubs. And their titles included not only strength-and-conditioning coaches and performance coaches, but also physiotherapists and academic heads of sports sciences. After using the prototype, each received a questionnaire with 4 questions and spaces for them to comment more generally on the prototype. All 22 of the practitioners responded to this questionnaire.

The first question asked the practitioners whether each had adopted, in part or fully, an option provided by the *Sport Sparks* prototype to address the athlete's challenge. Although no practitioner replied *yes fully*, 19 of the 22 replied *yes in part*, and only 3 replied *no*. This first result was more positive than expected in light of the crude nature of the prototype, especially as some of the practitioners had reported that the auto-generated guidance was sometimes incoherent, e.g., "*some of the sentences were incoherent relating to possible solutions*". Nonetheless, answers indicated that *Sport Sparks* had the potential to be a tool that coaches might use to resolve athlete challenges.

The remaining 3 questions elicited answers about the extent to which *Sport Sparks* was perceived to support creative thinking about athlete challenges. Answers are summarized in Table 1. Their results revealed that even the 3 practitioners who did not use any *Sport Sparks* support to solve the athlete challenge in the first question did not reject its impact on their thinking about the challenge.

Table 1: Responses from 22 professional coaches reporting the certainty that each perceived about *Sport Sparks* support for different creative thinking activities

	How certain are you?				
	Extremely	Very	Somewhat	Not so	Not at all
Sport Sparks offered an alternative view to your performance question?	2	12	3	5	0
Sport Sparks provided an alternative option to consider for performance questions?	2	8	7	5	0
Sport Sparks influenced your decision-making around answering performance questions	0	8	12	2	0

In response to the second question – *how certain are you that Sport Sparks offered an alternative view to your performance question?* – 14 of the 22 of the sports practitioners who responded were *very certain* or *extremely certain*, and another 3 were *somewhat certain*. One comment revealed the value of support for creative thinking from different perspectives, "*Having time to go through a process such as this allows other perspectives to be explored and time to think about the problem(s) through a different lens. As a relatively less experienced coach, this allows me to have more options on the table that I would not have even considered before*". Other comments revealed that *Sport Sparks* encouraged the practitioners to view the challenge more from the athlete perspective, e.g., "*This exercise allowed me to stop and reflect on the possible problem and I was able to begin to articulate what was really important to for the athlete and skinned away any noise…. The tool made me aware of the other factors that may also play important roles in the puzzle and I now have more clarity around how I can navigate to a subsequent solution*". Another reported "*I had not previously considered the athletes perspective of the situation. Nor did I consider the history of the athlete with other members of the organization which could massively impact the buy in required. The tool has allowed me to approach the problem with more empathy and realization that a shift in motivation/ behaviour won't happen instantaneously and that it is in itself a process. From the use of the tool, I will speak in person with the athlete to get a better understanding of their perspective and where their motivation truly lies*". And another reported "*Sport Sparks has allowed me to gain alternative perspectives on the challenge. Considering the approach of the whole MDT (multi-disciplinary team) allows the process to be aligned and athlete centre*". Some coaches were also positive about the generated constraints and their support for exploring the athlete challenges from more diverse views, e.g., "*I found the removal of constraints section especially useful*".

In response to the third question – *how certain are you that Sport Sparks provided an alternative option to consider for performance questions?* – most of the practitioners were either *very certain* (8) or *somewhat*

certain (7), indicating that *Sport Sparks* was perceived to be effective, although less effective for providing alternative options than it was for providing alternative views. Some of them reported creative idea generation with *Sport Sparks*, e.g., "*One of the ideas forced me to think and immediately gave me an idea to attempt to tackle the problem in a different way*". By contrast, others answered that use of the prototype did not change their solution to their current coaching problem, e.g., "*After having entered the performance problem into sports spark, my solution to the problem has not changed from own decision-making process*". Another commented that the scope to change coaching practices in some sports is limited, e.g., "*Based on the constraints of the sport and the culture the athlete has been around for such a long period of time, being able to change a small aspect of their current training (training during a competition week) is a challenging process*". That said, the same practitioner then added "*The tool allowed me to consider the impact of doing this on their mental well-being (lifting maximally more frequently per week). The implications will be to trial during training before dosing into a competition week*". Moreover, solutions generated by *Sport Sparks* also encouraged at least one practitioner to rethink the origins of the current coaching challenge "*Even though some of the ideas were not clear it did force me to think about the idea across many different domains. Switching between the different headlines pushed me to think about the origins of the problem from many different perspectives*".

Responses to the fourth question revealed that most practitioners were either *very certain* (8) or *somewhat certain* (12) that *Sport Sparks influenced their decision-making around answering performance questions*. One commented on the structure of the prototype's support "*I believe I had the solution to hand. So, it didn't offer an alternative solution. It provided me with more rigor in questioning to be more certain that the option I had in my head, was most likely to be the best option*". Another reported the advantages of the structured approach "*This allowed me to be very specific and clear in my prescription and delivery*". And a third reported that some learning was needed to use the support, e.g., "*Second time with this question. I'm getting more used to the structure of the questions*".

To conclude, the questionnaire responses were more positive than expected, given that *Sport Sparks* was a first prototype with limited functionality and user testing, no prior training, and no support to use. The results had implications for the next stage of the design research.

7. CONCLUSIONS, NEXT STEPS

This short paper reports the results of a design science approach to explore the feasibility and performance of a designed artefact – the *Sport Sparks* prototype – with the explicit intention of improving the functional performance of that artefact. Although this co-designed first prototype was simple – some of the algorithms generated incoherent content, and the coaches were unable to save or return to athlete challenges between sessions – 22 coaches working in at least 6 different sports reported potential benefits of the digital support for their professional coaching work. The authors are currently engaged in the next steps, which to redesign and reimplement the *Sport Sparks* prototype for longer-term evaluations. A new, more complete version is being developed with more refined algorithms. The authors plan to evaluate this new version in a professional football club in 2021.

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