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"A feeling for run and rhythm": coaches' perspectives of performance, talent, and progression in rowing

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ABSTRACT

The understanding of rowing performance has been predominantly gained through quantitative sports science-based research. In combination with this objective information, coaches' experiences may provide important contextual information for how this quantitative evidence is implemented into training programmes. The aims of this study were to (1) explore coaches' perspectives of performance indicators for competitive rowing in junior rowers, and (2) identify coaches' recommendations for developing effective technique and movement competency among junior rowers who have the potential to transition to elite competition. Twenty-seven semi-structured interviews were conducted with experienced rowing coaches through purposive sampling of an accredited coaching network. Participants' coaching experience ranged from 5 to 46 ($M = 22$, SD = 10) years. Data were analysed using thematic analysis. Three overarching themes were identified including, (1) getting the basics right, (2) targeting types of talent, and (3) complexities of performance. Based on these findings, sequence and boat feel, supported through the movement competency provided by hip flexibility and the trunk musculature, were considered critical for executing correct technique. Developing talent and understanding successful performance are both complex concepts when considering the individual athlete. Coaches' perspectives provided insight into key components of performance to enhance our understanding of how to better develop junior rowers.

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Introduction

Research on both the physiological and technical aspects of rowing performance has predominately used quantitative research methods (Yusof et al., 2020). Alongside such information, coaches' knowledge gained through years of experience evolving and refining training for junior rowers to become successful elite athletes may provide important contextual information for how quantitative evidence is integrated for superior performance outcomes (Burnie et al., 2018). Yet, the expertise of coaches has often been overlooked as a source of information to ask and answer important research questions (Bishop, 2008; Greenwood et al., 2012; Roberts, 2021). Coaches' perspectives are generated from their experience witnessing performance at the highest level, consistency in judgement, discriminative ability, behavioural characteristics and knowledge (Shanteau et al., 2002). This insight can inform upon sport science concepts that are difficult to establish through objective experimental assessment. For example, when coaches' philosophies were explored on resistance training and its transfer to elite cycling performance, it was perceived that resistance training was essential and that this was best achieved through a combination of non-specific resistance training and resisted sport movement training (Burnie et al., 2018). Given the high degree of freedom involved in designing training studies to quantitatively investigate this finding, without the collective input from coach expertise, this type of observation may have remained unknown. Similar examples of expert coaches enhancing our understanding of the complexity of sports performance have been reported in cricket, gymnastics, and track and field (Greenwood et al., 2014; Phillips et al., 2014). Accordingly, coaches' perspectives can provide a rich source of highly relevant information which can contribute to our understanding of rowing performance.

Rowing is a demanding sport. Successful elite performance requires physical, psychological, tactical and technical expertise (Soper, 2004). Rowers must have a high level of skill for the effective transfer of force from the rower to the boat. Large foot forces are applied to the foot stretcher and transferred through the human kinetic chain to the oar handle to propel the boat forward (Buckeridge et al., 2015; Kleshnev, 2016) (See Warmenhoven et al. (2018) for a more detailed description of the rowing stroke). Physiological and technical performance indicators both contribute to the overall boat speed. With this in mind, increasing technical efficiency for the same physiological output is a substantive reason for future studies to integrate the technical and physiological attributes of rowing more closely (McGregor et al., 2007). Much of the existing rowing research has focussed on physiological attributes such as aerobic and anaerobic capacity (Mikulic, 2008; Otter-Kaufmann et al., 2020); however, this information has not yet been contextualised to the technical output of the rower (McNeely,

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2019). For example, an array of biomechanical parameters associated with rowing performance have been recognised (Baudouin, 2002; Soper, 2004; Warmenhoven et al., 2018), such as stroke-to-stroke consistency and stroke smoothness as key technical indicators that discriminate between rowers of different skill levels (Smith & Spinks, 1995). Likewise, resistance training in rowing has been addressed in the literature (Lawton et al., 2011; Thiele et al., 2020). For example, elite rowers have been shown to be significantly stronger than their sub-elite and non-elite counterparts (Lawton et al., 2011). However, it appears that the relationship between physical and technical attributes in a performance context are yet to be integrated.

Movement competency provides an avenue to integrate physiological and technical attributes of an athlete. By definition, movement competency refers to the fundamental movements required of the athlete and is a combination of the biomotor qualities of force development capacity, flexibility and neuromuscular coordination (Missitzi et al., 2004; Rogers et al., 2020). Collectively, these fundamental qualities support skill execution by providing an athlete with a platform to perform a variety of multi-modal activities in an optimal manner (Kritz et al., 2009; Rogers et al., 2020). For example, maximal force transmission can be reduced if a rower lacks the flexibility to achieve an optimal catch position or lacks the stability provided through the hip and trunk musculature to anchor the pelvis and develop force through the leg drive (Young, 2019). While the rowing injury literature has addressed the movement competency requirements of the rower for the purposes of injury prevention and treatment (Clay et al., 2016; Soper & Hume, 2004), the use of movement competency for performance-based outcomes are yet to be fully explored (Rawlley-Singh & Wolf, 2022). Despite some evidence in on-water rowing, the relationship between movement competency, technical efficiency and performance is well established in other sports. For example, a strong relationship exists between running technique, economy and performance, demonstrated through kinematic variables such as trunk forward lean to explain the variability in energy cost and performance (Folland et al., 2017). Similarly, sport-specific strength training interventions have resulted in improved biomechanical parameters, physiological efficiency and subsequent performance for swimming and cycling, respectively (Morais et al., 2018; Vikmoen et al., 2016). Understanding the importance of the movement competencies of junior rowers and the influence on their technical output during on-water rowing is critical to performance and progression to the senior level. McGregor et al. (2007) noted the importance of increasing biomechanical efficiency for the same physiological workload, however, it is still not clear what aspects of technique are important for predicting on-water rowing performance. A notable gap remains in the understanding of how the development of movement competency could be integrated with biomechanical parameters of technique for superior performance outcomes (McGregor et al., 2007).

Performance-based research can lead to more practical applications for coaches, athletes, and support staff. Furthermore, the physical readiness of a developmental athlete can have a substantial impact on their transition from the junior to senior level of their sport. Identification of the movement competency required to be able to execute a technically efficient rowing stroke is essential to better understand junior athlete development (Rogers et al., 2020); however, the literature is currently limited. This research sought to leverage coach experiential knowledge to further our understanding of how to nurture and develop potential talent through the provision of appropriate training and resources (Baker et al., 2012). Rather than investigate talent identification, which is a systematic process of detecting potential ability in a sport and involves a comprehensive model leading to successful results (Nurjaya et al., 2020). Adopting a qualitative approach, coaches' perspectives of key performance indicators for competitive rowing including the physical capacity and technical requirements of the athlete and how these attributes affect rowing performance was explored. This differs to the "coaches" eye" which refers to the coach's ability to assess and identify talent and make decisions about talented athletes in sport (Jokuschies et al., 2017; Lath et al., 2021; Roberts, 2021). Further, the research aimed to report coaches' recommendations for developing effective technique and movement competency to optimise training practices among talented junior rowers who have the potential to transition to elite competition.

Methods

Participants

Rowing coaches were recruited to participate in interviews via an invitation letter that was sent to accredited coaches through the National Coaching Accreditation Scheme (NCAS) within Rowing Australia. Inclusion criteria required a minimum of 5 years coaching experience, regardless of the level of athlete they were coaching. Ethical approval was obtained from the University of Technology Sydney Human Research Ethics Committee and all participants provided written or verbal informed consent before the interview commenced.

Twenty-seven coaches (22 males and 5 females) were recruited through purposive sampling of an accredited coaching network. Participants' coaching experience ranged from 5 years up to 46 years, with a mean of 22 years (SD = 10). Most of the participants had coached at multiple levels of the sports pathway at different stages of their career including school rowing programmes, local clubs, national teams, and Olympic crews. In addition, all coaches had experience coaching different genders during their careers. At the time of the interviews, six participants were primary coaching female athletes, eight participants were coaching male athletes and 13 coaches were coaching both genders. Coaches were asked to draw on these diverse experiences when answering the questions.

Procedures

One-on-one interviews lasting approximately 45 min were conducted via an online platform to explore coaches' perspectives on performance indicators in rowing at elite and junior levels of competition. A semi-structured interview guide was utilised to allow the researcher to identify specific areas of enquiry, while providing flexibility in the

conversation for the participants to raise new topics that the researcher could further probe (Clarke & Braun, 2013). The guide was divided into four topic areas: key performance indicators in rowing, rowing technique in development rowers, movement competency in development rowers and participant background and personal coaching experience. Interviewing techniques, such as the use of probing and follow-up questions were used to encourage depth and authenticity of the responses (Rubin & Rubin, 1995). Questions in the interview guide started with indicators and attributes associated with rowing performance. Subsequent topics narrowed the focus on development rowers' technique, movement competency and path for progression to an elite level over the course of the interview. For example, one question asked the coach to discuss areas of technical focus that tend to be executed poorly in junior rowers regarding performance when compared to elite rowers. The terms junior and development in this study refer to athletes under 19 years of age who are progressing through the various and undulating stages of their sport (Gulbin et al., 2013). Each question limited responses to three attributes with the purpose of narrowing coaches' focus and encouraging them to prioritise the most important performance attributes (DeWulf et al., 2017). However, this approach did not restrict further probing and exploration of topics that arose during the interviews. Participants were assigned a number when the interviews were transcribed, and names were removed at this stage of the data process. Pilot interviews were conducted to assess timing of the interview and clarity of the questions.

All the coaches were interviewed individually, providing each participant the time to respond to all the questions in a non-competitive environment and elaborate when they had further insights. The lead author (NL) conducted all 27 interviews and transcribed all the audio recordings verbatim into word processing software. KS and MW both reviewed a sample of interviews with the transcriptions to check for accuracy. The lead author had experience as a sports science service provider with rowing, dealing with elite coaches and athletes, and an understanding of the colloquial language of the sport. This helped to establish a rapport with the participants and assisted in the interpretation of results (Patton, 2002).

For the purpose of the interview the physiology and physicality of the developing rower were considered two separate attributes, and these were clearly explained to the participants before the interview commenced. Physiology was defined as the aerobic, anaerobic, and force generating capacity of the rower (Volianitis et al., 2020). Physicality referred to the movement competency of the athlete and the rower's ability to move through a range of motion that is required to execute an effective rowing stroke (Rogers et al., 2020). This included the force development capacity, neuromuscular coordination and flexibility to hold an effective and safe posture throughout the stroke. Appropriate physicality allows large foot forces to be transferred from the foot stretcher through the human kinetic chain to the oar handles and blade connection with the water to propel the boat forward (Buckeridge et al., 2015; Kleshnev, 2016).

Data analysis

Interviews were audio recorded to a secure online platform (AARNet CloudStor, Chatswood NSW, Australia), transcribed using Microsoft Word (Version 16.52), and analysed using NVivo12 software (Version 6.5.1) and Microsoft Excel (16.52).

Using an iterative process with data collection and transcription, inductive thematic analysis was utilised to analyse the data (Braun & Clarke, 2019, 2021a; Braun et al., 2016). The analysis was approached from a critical realist standpoint, recognising that whilst an objective reality exists, people's experiences and interpretations of reality provide a basis for knowledge (Archer et al., 2013). Herein, coaches' perspectives are understood to be a reflection of their unique characteristics and experiences of rowing and coaching athletes. Thematic analysis is often used when the existing body of knowledge on a topic is limited, such as coaches' knowledge on technical and movement competency attributes associated with rowing performance in junior rowers (Quesnel, 2016). This method of data analysis emphasised exploring, recognising and discovering patterns and identifying themes within the data set (Braun & Clarke, 2006). Initially, the researchers became familiar with the data through careful and repetitive reading of the transcripts to recognise common patterns. During the subsequent phase of analysis, the initial coding was completed using codes in NVivo12. The data was analysed according to each of the three main topics by coding and categorising responses. The topics were subsequently classified into categories and subcategories. For example, boat feel was a category, and subcategories were rhythm, run and recovery. Categories were named based on the most common concepts shared by the sub-categories.

In the next phase of analysis, organised codes were clustered to develop candidate themes (Smith et al., 2016). These themes were discussed and reflected on by [blinded for peer review]. From these higher-level patterns, finalised themes were named through rich analysis ensuring the themes related back to the research question and aims of the study. Table 1 provides an overview of themes, subthemes, and codes. Sample size was determined in advance for the purpose of ethical obligation, however interviews continued until the lead author made an interpretative judgement that participant responses grew repetitive, and the goals of the analysis had been achieved (Braun & Clarke, 2021b). The reporting of this study aligns with the Consolidated criteria for Reporting Qualitative Research (COREQ) (Tong et al., 2007).

Results

Three overarching themes were identified including, (1) getting the basics right, (2) targeting types of talent, and (3) complexities of performance. In line with current literature, each subtheme is described by two coach quotations (Eccles et al., 2009; Eldh et al., 2020; Greenwood et al., 2012).

Getting the basics right

Coaches identified key differentiators between junior and elite rowers across areas of technique, training consistency

Table 1. Overview of themes, subthemes, and codes from the thematic analysis.

Themes	Subthemes		Codes				
1. Getting the Basics Right	*Key differentiators between elite and junior rowers*		Sequence – drive & recovery	Coordination of the sequence	Timing	Blade Skills	
2. Targeting types of talent	*Consideration of innate versus trainable qualities in junior rowers*	**Innate Qualities**	Boat feel	Boat run	Rhythm		
		Trainable Qualities	Aerobic capacity	Connection	Training consistency	Core stability, strength & strength endurance	
3. Complexity of performance	*Critical factors to develop physically competent and technically effective junior rowers*		Physiological talent	Natural power	Strength at the catch position	Hip mobility and range of movement	Gluteal engagement and force development capacity

and movement competency characteristics that they described as fundamental attributes for rowing success. From a technique perspective, the sequence and timing of the rowing stroke was the main concept when discussing technical skills in junior rowers. For elite rowers, from the moment the blade is placed in the water, the blade movement becomes horizontal, the rower's weight is lifted from the seat and suspended between the handle and foot stretcher. The force is initially created through knee extension but quickly shifts to hip extension as the trunk swings open (Kleshnev, 2016). Three quarters of all coaches interviewed recognised that junior rowers are still developing this appropriate sequence of movements to be able to generate optimal force production during the drive phase and maintain optimal boat run during the recovery phase. Coaches believed this was a key factor that separated them from the more senior elite rowers. C13, a national team coach with 20 years' experience, describes the technical faults and areas required for development they have commonly seen in sequencing amongst junior rowers,

> [In junior rowers] the sequencing, lifting the body early, instead of the leg drive and not getting the body over enough at the recovery, so off the back. (around the finish)

C21, a national team coach with 13 years' experience further explains,

> More prevalent in the development age athletes would be that they pull the oar rather than push the feet, there is a lot more lift, a lot more arm engagement, they have very little trust in their leg strength … they think rowing is a pulling sport, rather than trying to push the seat away from the feet … it's actually a pushing sport.

Consistency in junior rowers' stroke-to-stroke technique and in their application to the training workload was also recognised as deficient in comparison to their elite counterparts. This is not unexpected given the age and maturity of this group of athletes as explained by C10, a national team coach with 15 years' experience,

> Young rowers' physical maturity and their ability to handle work … an older athlete can handle 20-30kms day in, day out, but junior rowers might have a good session and then the next day is terrible, they can just be inconsistent with everything.

The concept of being able to tolerate the workload required to be successful was also identified by C5, a former Olympic coach with 46 years' experience who reflected on what is essential,

> Successful athletes require a desire to work physically hard and accelerate the boat every stroke, consistency over time, most young kids can be heroes for a minute.

Another fundamental area that the coaches commonly observed junior rowers lacking was movement competency. In rowing, this refers to a specific range of motion and force development capacity to be able to execute an effective rowing stroke. For junior rowers, discussions focussed on how flexibility and trunk musculature limited the ability of less experienced rowers to support their body during the stroke. Interestingly, a wide range of terms were used to describe movement competency. Coaches referred to trunk musculature and its force generating capacity using the terms, "core" and "posture" in combination with stability, strength, and strength endurance. The coaches' term, "trunk strength" refers to the force development capacity of that body region. The words core and posture were used interchangeably in reference to the rower's trunk strength during the stroke. C21, a national team coach, with 13 years' experience describes this generalised characteristic of junior rowers,

> They just can't get out there (the catch position) for a good length … core strength is a bit of a ubiquitous sort of term but these kids' ability to hold themselves up to hold themselves in a good position, to sit on top of their pelvis a bit and not collapse underneath it, they are still developing a lot.

Flexibility in the lower body from the hips through to the ankles was an area where coaches also saw junior rowers struggling to achieve certain positions in the rowing stroke. Poor flexibility was commonly discussed, specifically in reference to young male rowers, often as a limiting factor in relation to the catch position, which is considered very difficult as it requires full hip flexion, knee flexion and ankle dorsiflexion whilst maintaining a neutral spine. C27 an international coach with 20 years' experience, explains the difficulty of the catch position for young rowers,

> Hip pivot, compression into the front end, just being able to get your seat really close to your ankles while still maintaining a good posture at the same time. I suppose two aspects of that is being able

> to slide into that position but also being able to hold that position, so often it's a difficult position to sit in, it's like sitting in a squat.

Junior rowers are often still growing and physically maturing, and this can alter their flexibility and ability to move during this period. The gender difference amongst junior rowers was well described by one coach (C20; national team coach with 9 years' experience) who primarily coached junior male athletes, explained,

> If the boys don't stretch, they don't have the right posture, and they if don't have the right posture, there is too much pressure on the lower back … we see the boys still growing when they are 16, 17, and 18 and this is when their level of training is much higher whereas the girls finish growing usually by 14 before the training workload really starts to increase.

The notion of gender specificity in junior rowers suggests that research investigating potential differences is essential (Johnston et al., 2018). This, in accordance with that literature, signifies how men and women respond differently to certain training stimuli and how gender should be considered when prescribing a training programme (Altavilla et al., 2017). Sequence, timing, and movement competency were identified as fundamental attributes for junior rowers; however, this may require consideration to distinctive requirements for men and women rowers during different stages of their development.

Targeting types of talent

When coaches considered the most important aspects of performance, it drew them to consider types of talent and how to best target talent. Two related sub-themes were established out of this concept around talent: trainable qualities and innate qualities.

Trainable qualities referred to how coaches largely appreciated that rowing is predominantly an aerobic sport, and a high aerobic capacity is essential for success. C8, a national coach with 20 years' experience explained,

> The application of power in the drive phase is what makes someone a champion … when it comes to the physical it's hard to define it exactly because there is a range of people that are successful but aerobic capacity must be the most important factor when we are talking physical attributes.

However, there was a concept that developed within a small group of coaches who, through experience, noted that aerobic capacity appears to be more easily trainable than strength. These coaches would preferentially choose naturally strong athletes over athletes with a naturally high aerobic capacity. The coaches' responses were based around their experience that it is easier to train and improve an athlete's aerobic capacity than it is to train an athlete to be stronger. C2, an Olympic coach with 35 years' experience explained,

> Endurance is super important, you need strength-endurance, but the athletes that have pure power are able to over time train their aerobic capacity whereas the ones that have just a really high level aerobically aren't able to always push the strength.

C4, another Olympic coach with 30 years' experience further explained,

> I've always felt that strength is really important because it's the thing that you can probably change the least in a rower and you have to be strong naturally … I think that's probably a pretty important physical attribute for a rower because it's the hardest thing in my mind to change, if someone is just basically weak, they are just basically weak, I can get them fitter and improve their endurance base, but I haven't been able to make them stronger, so they've got to be genetically strong.

This concept of trainable qualities, comparing aerobic capacity and strength is not currently reflected in the literature and certainly warrants further investigation with potential benefits for future talent identification.

Further to the idea around identifying talent was innate qualities. Discussions revealed an understanding of boat feel and rhythm to be more of an intrinsic trait or innate quality associated with technically competent and efficient rowers. Similarly, swimmers refer to a feel for the water, and its associated with talent in swimming (Ganzevles et al., 2019; Toussaint & Beek, 1992). An understanding and feel for the boat run may be associated with minimising fluctuations in boat velocity throughout the stroke cycle, which directly relates to better rowing performance outcomes (Hill & Fahrig, 2009). C13, a national team coach with 20 years of experience describes this innate quality of boat run and rhythm,

> One that's hard to quantify is just feel for the water … they either get the feeling or they don't get the feeling, of catching the water, accelerating the boat underneath them and they can feel it in other things they do too … some of them may be a good skateboarder or bike rider, they can feel movement.

Similarly, C26, a national team coach with 16 years' experience describes the innate feel for boat run and rhythm,

> A feeling for run and rhythm, so that you're able to time the front turn and apply yourself well, to pick the boat up sharply is quite important and that's the ability to feel for the boat run and rhythm, to time your movements through the front turn and be able translate that into the boat pick up.

Coaches' awareness of these innate qualities, and the ability to identify athletes who possess these traits may assist identifying potential talent. In addition, educating current junior rowers on these attributes such as specific training drills to improve boat feel may progress their development and subsequent performances.

Complexity of Performance

Further to the theme on talent was the complex and dynamic process to assess performance. The interview structure limited coaches to selecting their top three attributes in relation to different aspects of performance for both elite and junior athletes. Over the course of the interview, coaches frequently mentioned the difficulty in narrowing performance down to the top three parameters. This highlights the complex and dynamic process coaches use to assess performance. In response, C6, an international coach with 25 years of coaching experience explained,

> This is such a hard question to answer because we have twenty-four athletes, they are all different and they are all successful. Some of our best athletes are some of our weakest athletes in the gym but what do they bring? It's their ability to move the rowing boat, it's a really difficult question to answer.

C9, a national coach with 17 years' experience described the difficulty in narrowing performance down to their three most important attributes, whilst also highlighting the differences between being a successful junior and successful elite rower,

> It's difficult . . . you can't necessarily have 3 priorities and then sort of disregard the rest. I know it's just a question, but you have to be strong in half a dozen areas if you want to make it that far, whereas if you're looking at juniors you could have one of six things and be really good at that and you could make a junior team.

The sport of rowing magnifies the complexities of sports performance and the attributes required for success with multiple boat categories involving one, two, four or up to eight people in a crew. In addition, there are two types of rowing: sculling and sweep rowing. In sculling, each person has two oars and in sweep rowing, each person has one oar each. C3, an Olympic coach with 16 years coaching experience explained how the requirements of single sculling (i.e., one person in a boat with two oars) differ to that of crew boat rowing,

> I can't help but think performance is being the fastest and . . . sculling performance is quite unique and more influenced by a narrower set of factors probably than in rowing sweep or crew boat rowing where there are just so many examples of people where they just might be missing one of those three attributes but they have two of the others, I can just think of too many variations of very successful people . . . in single sculling I'm a little bit more narrow minded about it.

Further, C4 an Olympic coach with 30 years' experience, provides an example that describes the variable aspects of performance presented by successful crews, reinforcing the complex nature and individual variability of elite and successful sports performance whilst highlighting some psychological traits that are required for success,

> I think there has to be some degree of synergy and I can think of a previous Olympic gold medal crew in an eight who were untouchable, probably one of the best eights that's ever been put out but technically they were terrible . . . water coming off the shafts, but they were awesome and I think in that category of boat, the eight, you can get away with quite a lot of sloppy stuff if you've got very good engines and a real good camaraderie, confidence, and team morale type focus.

Psychological aspects of performance were mentioned early in the interviews when the initial topic of performance attributes was being introduced and the scope of the discussion was not yet focussed on movement competency and rowing technique. Rubin and Rubin (2011) identify these initial questions as tour questions as they provide a tour of the topic. Mental attributes desired by the coach's included determination, focus, resilience, intent, and motivation as traits when considering talent for future rowing success. In the context of developing talent, C12 an Olympic coach with 43 years' experience describes the need for intent,

> The ratio of the person in front of me, their shape, flexibility, coordination, power and their intent is a psychological construct, their intent, and their motivation to pull hard and get some kick out of that, these are things people need to bring to the party.

In summary, the themes that were developed through higher-level analysis whilst addressing the research question, highlighted the complex nature of athlete development, talent identification and performance outcomes in the context of rowing. Coaches recognised that the main focal areas for the technical efficiency and movement competency in junior rowers involves getting the basics right, including important characteristics (i.e., aerobic capacity and innate boat feel) when identifying talent, whilst also appreciating the complexities and dynamic nature of performance.

Discussion

Experimental research has individually highlighted the physiological (Otter-Kaufmann et al., 2020) and technical requirements (Holt et al., 2020) for rowing performance; however, how these factors interrelate and contribute to competitive success has not yet been explored. Rowing coaches' experiential knowledge can help to evolve our understanding of the relationship between movement competencies and technical efficiency in junior rowers. Elite rowing performance requires talent, physical and psychological attributes and technical qualities across many areas (Nurjaya et al., 2020) and coaches confirmed their understanding of this concept. "Getting the basics right" was a theme that highlighted key differentiators between junior and elite rowers and if the basic fundamental movement and skill requirements are not established as a junior athlete, progression to the elite level may be hindered along with the opportunity to further develop higher order skills like crew synchrony and boat feel (Millar et al., 2013). In line with results from previous experiential research (Burnie et al., 2018), characteristics of technique, training consistency and movement competency were identified as important factors that contribute to successful rowing performance.

Coaches' knowledge on the importance of movement competencies, such as flexibility and trunk force development capacity in junior rowers was apparent (Gee et al., 2011; Steinacker et al., 2020). Further the subsequent impact to the on-water rowing technique due to poor movement competency was also highlighted by some coaches. A recent study by Rawlley-Singh and Wolf (2022) highlights the importance of recognising range of movement and force capability requirements specific to the rowing stroke. However, the literature is limited, and each discipline has often been studied in isolation. For example, movement competencies, such as flexibility and posture, have been considered in the context of injury prevention, not specific to on-water performance and technique (Nugent et al., 2021; Wilson et al., 2013). Rowing technique has been studied in the sports science subdiscipline of biomechanics with intent to improve performance, yet this has been undertaken in isolation from the movement competency required to execute the technique (Černe et al., 2013; Mattes et al., 2015). Future research should investigate the effect of improving aspects of junior athletes' movement competencies and explore the effect on their on-water rowing technique. This has the potential to inform training practices, improve junior performance, promote progression to the elite level and potentially reduce the risk of injury which directly relates to performance (Buckeridge et al., 2015; Nugent et al., 2021).

Gender differences were noted by coaches, with junior males believed to be more limited in flexibility through the hips and ankles leading to increased injury risk. The

combination of substantial increases in training load and phases of rapid growth and physical maturity at this age were suggested as contributing influences. Further, in line with the coaches opinions, prolonged and intensive training loads in growing individuals are considered a risk for sustaining an overuse injury (Dalton, 1992) and overuse injuries are more common than acute injuries in rowing (Trease et al., 2020). Regular monitoring during periods of high growth in adolescents has been recommended to detect changes in flexibility that may be considered potentially high-risk phases for injury (Wild et al., 2013). This may allow for modifications in the training program to potentially reduce the risk of injury and loss of training time in junior (particularly male) rowers during these periods.

Getting the basics right in developing junior rowers progressed discussions to targeting types of talent. Two concepts of importance were trainable qualities and innate qualities for rowing performance. Innate talent in a sporting context can be defined as an attribute that is inborn or natural (Baker & Wattie, 2018). Boat feel and boat run were frequently mentioned as innate qualities in the present study. A "feel" for the water is pertinent in other sports like swimming to improve stroke technique. Talent in swimming has been associated with feel for the water through athlete's ability to achieve the optimal angle at attack to the water (Toussaint & Beek, 1992). Swimming coaches are familiar with athletes improving their feel for the water, and although a subjective expression, it is an important aim when training elite athletes (Ganzevles et al., 2019). Further, this suggests a connection between the feel for the water and optimising the intra-stroke velocity fluctuations due to the propulsive actions of arms and legs (Ganzevles et al., 2019). Similarly, in rowing, there is an intra-stroke velocity fluctuation cycle. This could be considered an important connection between the subjective expression of feel for the water and the objective measurement of intra-stroke velocity fluctuation, which has been linked to increased efficiency in competitive rowing (Hill & Fahrig, 2009). Interestingly, a qualitative research study has explored interpersonal coordination in elite crew boats and how crew synchrony is achieved through extrapersonal sources such as the feel for the boat and water (Millar et al., 2013). Results suggested more fundamental attributes such as force development capacity and stroke length were prerequisites to elite performance and thus as highly practiced individuals, allows them to make use of higher order invariants such as feel for the boat and water. In the absence of having an innate feel for the water in rowing, more fundamental attributes may need to be achieved prior to addressing the higher order skill of feel for the water.

Trainable qualities referred to the concept that force development capacity was more important because it is less trainable than aerobic capacity. In the context of a rowing race typically comprised of 80% aerobic metabolism (Yusof et al., 2020), this is a unique perspective not currently reflected in the literature. Further research may be warranted in a talent identification environment to assess prioritising naturally strong athletes over naturally aerobic athletes. In addition, current junior rowers and coaches may benefit from learning about the importance of these attributes, both innate and trainable, as it may assist in their development and level of performance achieved in the future.

Targeting types of talent flows into the final theme, complexities of performance, as the acquisition of becoming an expert or elite performer in any sport is a nonlinear process where athletes develop skills at different rates through their own unique pathway (Phillips et al., 2014) making a "one size fits all" approach to talent identification almost irrelevant (Baker et al., 2018; Vaeyens et al., 2008). Similarly, successful elite performance can be comprised of many different combinations of attributes, skills, and qualities. Limiting the list of performance indicators to a narrow subset of parameters for each coach was difficult, highlighting the complex nature of performance and the individual variability that exists even at the elite level of sport (Gulbin et al., 2013; Rose et al., 2013). It was challenging for coaches to rationalise the most important attributes for rowing performance. Despite the interview being an exercise in listing attributes in a priority order, coaches were drawn to discuss the variability they see amongst their own athletes who in some situations could all be considered successful at an elite level. This highlights the importance of the individual variability rather than the statistical average when describing performance (Rose et al., 2013).

Strengths and limitations of this research must be considered when interpreting the findings. The study findings are strengthened by the relatively large sample of coaches ($N = 27$) with an average of 20 years coaching experience, including 23 coaches with national team representation. However, the recruitment of coaches was restricted to the Rowing Australia network and, although there are standard techniques for on-water rowing, various performance and coaching styles have been adopted in different regions of the world (Kleshnev, 2016). Thus, the present findings may not be transferable to other contexts or technical models. In addition, the sports systems in Australia may vary to other countries, including approaches to talent identification and development in junior-level athletes. Accordingly, the generalisability of the results across rowing programmes in other nations may be limited. Regardless, the prolonged general success of Australia as a rowing nation in the past few decades means that the emerging themes identified in this research are ecologically valid in the context of a high performing development environment.

Coaches' responses were interpreted and reported based on the interview transcriptions. Coaching language does not often reflect the preciseness of scientific and academic literature, and the disconnect between sport science research and coaching practice is well documented (Eisenmann, 2017; Williams & Kendall, 2007). Examples in this study include the use of the term core by the coaches in reference to the force development capacity of the trunk. Coaches used the terms strength and power interchangeably in reference to the force generating capacity of the athlete or body region depending on the specific topic of the discussion. This paper aimed to bridge the gap between coaching practice and sport science research through integrating coaches' language in a sport science publication. It is hoped coaches and support staff concerned with rowing find the study insightful and accessible.

Conclusion

To our knowledge, this was the first study to explore coaches' perspectives on rowing performance indicators for competitive rowing with a focus on junior rowers. The experiential knowledge of expert rowing coaches interviewed in this study has contributed to the understanding of performance indicators and attributes pertinent to junior rowers. The sequence of the rowing stroke was highlighted as a critical technical focus for junior rowers, learning to coordinate the leg drive, body swing and arm draw for optimal force production. Concepts around movement competency concentrated on flexibility and trunk force development capacity for junior rowers. Subsequently, these focal areas of fundamental movement skills and basics of effective technique led to targeting talent and achieving successful performance outcomes. Identifying talent and assessing what makes up successful performance are both complex concepts when considering the individual athlete. Talent identification has been popular in recent decades however more recent research emphasises the concept of talent development (Vaeyens et al., 2008). The results of this study highlight aspects of both movement competency and technique required to enhance development in junior rowers. In addition, although not a focus of this study, psychological aspects of performance are an essential aspect of performance, and this was identified by the coaches. Future research could further explore coaches' knowledge on psychological aspects of training and performance in the context of talent development. To compliment the current findings of this experiential knowledge, experimental research could explore the effects of a training intervention targeting movement competencies specific to junior athletes' rowing technique and subsequent on-water performance. Such an approach could assist the development pathway including junior rowers, school rowers, coaches, and sport scientists in the utilisation of best practice training methods to achieve optimal and effective rowing performance outcomes, whilst also reducing the risk of injury at such an early stage of development.

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