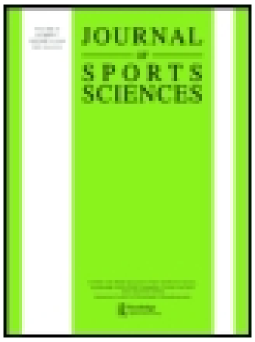

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Talent identification and deliberate programming in skeleton: Ice novice to Winter Olympian in 14 months

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Abstract

The aims of this study were to talent transfer, rapidly develop, and qualify an Australian female athlete in the skeleton event at the 2006 Torino Winter Olympic Games and quantify the volume of skeleton-specific training and competition that would enable this to be achieved. Initially, 26 athletes were recruited through a talent identification programme based on their 30-m sprint time. After attending a selection camp, 10 athletes were invited to undertake an intensified skeleton training programme. Four of these athletes were then selected to compete for Australia on the World Cup circuit. All completed runs and simulated push starts were documented over a 14-month period. The athlete who eventually represented Australia at the Torino Winter Olympic Games did so following approximately 300 start simulations and about 220 training/competition runs over a period of 14 months. Using a deliberate programming model, these findings provide a guide to the minimum exposure required for a novice skeleton athlete to reach Olympic representative standard following intensified sport-specific training. The findings of this study are discussed in the context of the deliberate practice theory and offer the term "deliberate programming" as an alternative way of incorporating all aspects of expert development.

Keywords: *Deliberate practice, expertise, talent development, talent transfer*

Introduction

In sport, significant resources are dedicated to the development of large groups of athletes in the hope of producing elite performers. It has been estimated that the expenditure required to achieve an Olympic gold medal is about A$37 million dollars (Hogan & Norton, 2000). However, many identified athletes fail to reach their potential, which raises questions regarding the most effective and efficient use of resources to ensure optimal talent development, retention, and ultimately successful athletic performance. If it were possible to minimize these type II errors (i.e. the false positives), this would enable sporting bodies to focus expenditure on developing a smaller number of athletes and offer more focused coaching and resources in their quest for elite performance.

Talent identification and development (TID) models in sport have typically focused on junior age (<18 years) athletes and involve two basic approaches (Williams & Reilly, 2000). Athletes already competing within a sport may be selected to receive additional coaching and higher competition opportunities within the same sport based on observed or measured potential (talent selection). The alternative pathway is the introduction of new talent into a sport if the individual demonstrates the desired multi-disciplinary, physical, psychological, and skill required for inclusion in that sport (talent detection) (Hahn, 1990; Hoare & Warr, 2000). Talent transfer also occurs whereby existing high-performance athletes are targeted and their athletic ability is transferred to another sport. Such paradigm shifts in talent identification and development increase the probability of identifying athletes that can attain senior expertise by minimizing adolescent maturational issues, reducing talent development time frames, and maximizing return on the developmental investment already made in these older athletes (Gulbin & Ackland, 2009; Halson, Martin, Gardner, Fallon, & Gulbin, 2006). In support of this

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accelerated talent transfer approach, a retrospective analysis of Australian senior national athletes showed that 28% reached their elite status within 4 years of starting the sport for the very first time (Oldenziel, Gagne, & Gulbin, 2004). These "quick" developers started the sport at which they attained senior national status at an age of 17.1 ± 4.5 years, and on average had participated in three sports beforehand (Oldenziel et al., 2004).

It is suggested that TID and talent transfer programmes are likely to be more successful in sports where the standard and international depth of competition is lower than in other sports (Baker, 2003; Hoare, 1998) and skeleton has been identified to be in this position. Skeleton, a relatively unknown Olympic sport, was re-introduced into the 2002 Olympic Games after a 54-year absence and hence it is unusual to find current athletes around the world with any form of skeleton sliding experience. At the onset of our TID campaign, we estimated that there were less than 100 registered women skeleton athletes worldwide. Of those, less than half had World Cup competition experience. Thus, skeleton offered a unique opportunity to identify a complete novice or target existing high-performance athletes to transfer into this sport. The ability to utilize existing high-performance athletes' skills and competition experience gave us the capacity to exploit talent gaps at the World Cup level by possibly compressing the developmental time frame of these athletes.

Applying a talent detection model in any sport requires an understanding of the measurable performance components required for senior international success. A skeleton run begins with an explosive push start where an athlete sprints for approximately 30 m in a bent over running position. The athlete then loads onto the sled to pilot it to the finish line as quickly as possible. A basic analysis from our laboratory in 2004 suggested that up to 50% of explained variance in World Cup skeleton performance could be attributed to the skeleton start. Recently, Zanoletti and co-workers (Zanoletti, La Torre, Merati, Rampinini, & Impellizzeri, 2006) found that the start could explain 23% and 40% of variance in overall skeleton performance for men and women respectively and suggested that a fast start time is a prerequisite for a fast skeleton run, but did not provide a clear means for predicting final ranking. The United States national skeleton team athletes are able to achieve 70–85% of upright sprint times in a bent over running position while pushing a "dry-land sled" (Sands et al., 2005). Therefore, the rationale of our talent identification programme was based on the finding that a fast push start in skeleton is important for overall performance and fast sprinting athletes in the upright running position could potentially be fast in a bent over running position. Sports that require athletes to maximally accelerate over a short distance were targeted and included track athletics (sprinters), surf life saving (beach sprint and flags), and short track speed skating. We also recognized that there were other factors that would be important for success, including equipment, aerodynamics, mental toughness, perceptual-cognitive skills, and quality of coaching (Abbott & Collins, 2004; Elferink-Gemser, Visscher, Lemmink, & Mulder, 2004; Morris, 2000; Reilly, Williams, Nevill, & Franks, 2000; Williams, 2000; Williams & Hodges, 2005).

The genesis and development of talent has recently been debated in two journals (*High Ability Studies* and the *International Journal of Sports Psychology*) dedicating full issues to point–counterpoint debates (2007). One controversial theory originally proposed by Anders Ericsson (Ericsson, Krampe, & Tesch-Romer, 1993) is the theory of deliberate practice. This theory of expertise development insists that elite senior national athleticism can only be achieved after beginning specific sports specialization as early as possible, and not until a minimum of 10 years of focused, effortful practice has been accumulated (Ericsson et al., 1993). This theory negates the concept of talent transfer and the aim of achieving excellence through late specialization and rapid development. Although deliberate practice in talent identification and talent transfer programmes is essential, it is an oversimplification of the role practice plays in the attainment of expertise. Rather deliberate practice is a subset of deliberate programming. Deliberate programming encompasses other planned factors in addition to skill practice by providing high-quality strategic planning, access to quality coaching, equipment, the best possible competitions, and technical, financial, and sport science and medicine support to ensure athletes fulfil their potential.

The main aim of this study, therefore, was to qualify an Australian female athlete in skeleton for the 2006 Torino Winter Olympic Games using a talent transfer approach. A secondary aim was to quantify the volume of skeleton-specific training and competition that would enable the first aim to be achieved. The findings of this novel study are discussed in the context of the deliberate practice theory.

Methods

Talent identification screening (Olympics minus 18 months)

A national campaign targeting women with a history of participation in sports involving explosive speed was undertaken throughout Australia in August

2004. Applicants were asked to perform an electronically timed 30-m sprint at a designated testing centre, with all times, personal interests, and training histories submitted to the Australian Institute of Sport (AIS) for interpretation. Before participation, athletes provided their written informed consent. All procedures used in this study had been approved by the AIS Ethics Committee.

Initial selection. From the recruitment campaign, 67 women submitted applications including their best 30-m sprint time. Based on 30-m time, the fastest 26 athletes were selected to attend further testing at the AIS in Canberra. The number of athletes invited for further testing was similar to that seen in previous Australian talent identification programmes (Hahn, 1990; Hoare & Warr, 2000). At the selection camp, the participants completed a full anthropometric assessment, re-testing of their 30-m sprint efforts, lower body power tests (box drop jump, unloaded and loaded 34-kg countermovement jumps), and dry-land skeleton sled push simulations.

Ten athletes were subsequently selected to attend a skeleton familiarization camp in Canada and participate in intensified skeleton training. Five of the 10 athletes were selected based on their 30-m sprint time alone, while the other five were chosen at the discretion of the coach and sport scientists. The athletes' ability to push and load the dry-land sled was ranked as the second most important variable following 30-m sprint time in the selection criteria. The ability to load the dry-land sled was subjectively assessed by the coach. For athletes who were deemed to have similar sled push and loading ability, the lower body power traits and the recognition of being a quality competitor (having already attained international success) and "team player" (subjective assessment of how the individuals interacted with fellow competitors during the camp) were used to discriminate between athletes. The anthropometric variables did not contribute to the selection process; rather, these measures were used for future reference.

Skeleton practice (Olympics minus 14 months)

During the overseas skeleton familiarization camp (2 months), athletes undertook specialized sled start training at an indoor ice-house facility to increase start performance competency. All 10 athletes undertook a similar number of complete ice runs ($n = 50$). Athletes also undertook ice-house push-starts ($n = 25$) and were provided with technical feedback by the coach and sports biomechanist within and after each session. The athletes started their on-ice sliding/driving training from curve 8 (juniors' luge start; the track had 14 curves in total). On day 2, the athletes started from curve 5 (ladies' luge start) and on the third day of training started from the top of the official bobsleigh and skeleton start (official start). Following the skeleton camp, all 10 novice athletes participated in four America's Cup competitions (one tier below elite World Cup competition). In addition to on-ice training and ice-house start training, all athletes had access to "point of view" sliding footage for all tracks on the America's Cup circuit. The number of times the athletes viewed the footage was self-selected by each individual. Following each sliding session, all athletes were given visual and verbal feedback where between two and eight sections of the track had been filmed. The athletes viewed this footage several times both in real time and slow motion.

Skeleton selection. After four America's Cup races, the five best ranked athletes from these races were selected to continue with the skeleton training and retained their AIS scholarships (Athletes A, B, C, D, and E; Table I). Towards the end of the 2004–2005 season, a further selection race was held where the two top placed Australian athletes (Athletes A and C) were selected to represent Australia in two World Cup qualification races (Challenge Cup). Australia finished second at this competition and qualified two positions on the women's skeleton World Cup Circuit for the 2005–2006 season. Athlete A also qualified for the 2004–2005 Skeleton World Championships.

Off-season training (Olympics minus 11 months)

Four of the five athletes (Athletes A, B, C, and D) retained their AIS skeleton scholarship following

Table I. Age, initial sport, length of participation, and highest standard of competition of the 10 selected athletes who participated in intensified training (September 2004).

Athlete	Age	Main sport	Length of participation	Highest standard of competition
A	21	Surf life saving	13	International*
B	18	Surf life saving/ gymnastics	12	State
C	18	Surf life saving	10	State
D#	29	Track (100 m)	20	International
E#	25	Track (100 m)	17	State
F#	27	Track (100 m)	20	State
G#	28	Track (100 m)	20	State
H	29	Water skiing	20	International*
I	31	Track (heptathlon)	20	State
J#	25	Surf life saving	18	International

Notes: This is not a comprehensive list of the sports participated in; rather, it identifies each athlete's main sport and length of participation in that main sport.
#These athletes were selected based on 30-m sprint time.
*At some point in their careers, these athletes had been World Champions in their sport.

a competition performance review. The reason Athlete E lost her AIS scholarship was due to poor competition results in the back half of the 2004–2005 season. No skeleton tracks are open during the off-season, thus international skeleton athletes mostly participate in dry-land training, similar to that of a sprint athlete but with specific sled push training. The four athletes who retained their scholarships embarked on a dry-land sprint and weights training programme for the following 6 months. During July 2005, these athletes revisited the indoor ice-house facility and experienced an intensive 10-day push start training camp. Following the ice camp, three athletes (Athletes A, B, and C) elected to undertake a 3-month full-time residential skeleton camp based entirely at the AIS in Canberra. Athlete D chose to stay at her home base but undertook a similar training programme to the other three athletes and came to the AIS every 4 weeks for 3 days of intensified dry-land push practice as she did not have access to this at her home base. The main aim of the 3-month full-time training programme was physical preparation – to make the athletes physically robust and injury resilient leading into their first full skeleton season, which would allow a maximum of one athlete to qualify for the 2006 Torino Winter Olympic Games.

Full-time dry-land training. At the AIS, the weekly training incorporated three sessions each of track training, strength and conditioning, and dry-land sled sessions with daily recovery sessions. The track sessions included one acceleration session, one maximal velocity session, and one general conditioning day (tempo running, easy drill work, bounding work). The strength and conditioning sessions included two heavy weights sessions and one circuit-type session. The dry-land push sessions focused on the technical aspects of the skeleton start, over-speed work using a sled attached to a treadmill, and maximal push efforts. The daily recovery sessions included contrast and cold water immersion. Soft tissue therapy and physiotherapy were available to the athletes at all times. The athletes' worked on a 3-week cycle that consisted of two hard weeks followed by an easier week. During the 3 months at the AIS, the athletes watched "point of view" footage for all skeleton tracks at their leisure.

Second season (2005–2006, Olympics minus 5 months)

On-ice training resumed in mid-October 2005 and national selections were held over 4 days and consisted of three races ($n = 7$). The top four performing athletes, who incidentally were those who retained their AIS skeleton scholarships during the off-season, were selected to represent Australia as the World Cup team. During the competition season, strength and conditioning maintenance programmes and a sprint programme were carried out. In addition to on-ice training, all athletes had access to "point of view" sliding footage for all tracks and were given visual and verbal feedback after all sliding sessions, with a minimum of two and a maximum of eight sections of the track filmed. The athletes viewed their own sliding footage and also that of their team-mates several times in real time and slow motion as a group feedback session led by the coach. From the video analysis, the driving tactics for the following day of sliding were determined.

Selection of the Olympic athlete (Olympics minus 1 month)

All athletes competed in two World Cup races. An internal race (all Australian athletes competed against each other) was held to determine which athlete would have the opportunity to compete in their third World Cup race (the fifth World Cup) before the Olympic nominations. Each athlete's percentage behind the winner was calculated for each athlete in each race, rather than using their placing. When the two best World Cup results were added together, the athlete with the lowest mean percentage behind the winner was nominated to represent Australia at the Torino 2006 Winter Olympics. Before the Olympics, all athletes participated in an additional World Cup and Europa Cup race and the three Under-23 athletes (Athletes A, B, and C) competed at the Junior World Championships held 2 weeks prior to the Olympic Games.

Results

Talent identification screening

The mean age, height, body mass, 30-m sprint times, and lower body power traits of the original 26 athletes are shown in Table II.

Intensified skeleton training

The characteristics of the 10 athletes selected from the initial camp to undertake intensified skeleton training are shown in Table II. These 10 athletes exhibited a higher average for the 30-m sprint time and were more powerful in unloaded and loaded countermovement jumps than the average of all athletes who tested for the camp (Table II). Five of the initial 10 athletes from the TID camp were selected based on 30-m sprint time (Athletes D, E, F, G, and J; Table I). Athletes B and I were selected based on their superior ability to push and load a dry-land sled. Athlete C was selected because she was deemed to show potential while pushing and loading the dry-land sled but also demonstrated exceptional lower body power traits compared with the other athletes in the initial screening group. Athletes A and H were recognized as quality competitors as they had been World Champions in their previous sport and showed good aptitude in the 30-m sprint, loading a dry-land sled, and lower body power traits. All 10 athletes had achieved at least state-level representation in their previous sports (Table I).

World Cup athletes

The age, height, mass, 30-m sprint time, and lower body power traits of the four athletes from the initial selection camp are displayed in Table II. The four athletes who represented Australia were slightly younger, heavier, and more powerful (higher power in the unloaded and loaded countermovement jumps) than those who were selected for initial skeleton training (Table II). However, the 30-m sprint times of these four athletes were the same as the mean of the group of 10 athletes. Two of the athletes (Athletes A and D) had already represented Australia in their previous sport (Table I).

During the 3-month intensified dry-land training, these four athletes' 30-m sprints were tested during the light weeks: 3 weeks into the full-time training (July) and at the end of the camp (September). The mean 30-m times in July 2005 were 4.17 ± 0.06 s and in September 2005 they were 4.19 ± 0.08 s. Every athlete's time was slower in July and September compared with their programme entry time the year before. The decrease in speed was attributed to the intensive training they were currently undertaking. In mid-September, the athletes returned to their respective homes for 4 weeks to "freshen up" and arrived back at the AIS to re-test their 30-m sprint times prior to their overseas departure. Three of the four athletes achieved a personal best time in their 30-m sprint (group mean 4.10 ± 0.08 s).

Table II. Performance test results of all participants who attended the initial selection camp (September 2004), those selected for intensified skeleton training, and the athletes who eventually represented Australia on the World Cup circuit (mean $\pm s$).

	Initial screening	Intensified skeleton training	World Cup representatives
Number of athletes	26	10	4
Age (years)	25.2 ± 4.6	25.7 ± 4.6	22.2 ± 5.1
Height (m)	1.68 ± 0.03	1.68 ± 0.03	1.69 ± 0.05
Mass (kg)	62.6 ± 6.5	62.6 ± 6.5	64.5 ± 8.7
Sum 7 skinfolds (mm)	85.7 ± 25.5	72.2 ± 16.7	80.8 ± 26.0
30-m sprint time (s)	4.26 ± 0.13	4.14 ± 0.11	4.14 ± 0.11
Box drop jump ratio#	3.20 ± 0.79	3.16 ± 0.58	3.33 ± 0.25
Unloaded jumps			
Power ($W \cdot kg^{-1}$)	52.3 ± 7.2	55.1 ± 6.4	56.0 ± 6.1
Jump height (cm)	43.2 ± 5.0	45.6 ± 4.8	44.9 ± 1.2
34-kg loaded jumps			
Power (W)	472 ± 39	496 ± 37	514 ± 50
Jump height (cm)	8.9 ± 13.3	9.4 ± 14.8	8.47 ± 16.4

Note: It was not appropriate to conduct a statistical analysis to identify differences between groups in Table I, as each sub-group included athletes who made up the other groups.
#Box drop jump ratio is flight time/contact time.

Training and competition volume

The total number of start simulations, full runs, and competition runs leading up to the Olympics are shown in Table III. Due to limited track access and available ice times, 58% of the skeleton training was completed in simulation format, while 42% of the training involved full top to bottom sliding either during training or competition.

Discussion

The aims of this study were to qualify an Australian female athlete in skeleton for the 2006 Torino Winter Olympic Games and quantify the volume of skeleton-specific training and competition that would enable this to be achieved. The athlete who qualified for the Olympic Games (Athlete B) did so after approximately 300 start simulations and about 220 training/competition runs in a 14-month period. Athlete A qualified for the World Championships in her first skeleton season and was placed thirteenth in a field of 24, despite being the least experienced slider. In addition, Australia achieved four top-six individual rankings in their first World Cup campaign, finished sixth overall in the World Cup nation ranking, won a Junior (Under-23) World Championship (Athlete A) title, and finished thirteenth at the

Table III. Total number of ice house, dry land, training, and competition runs over the 14-month period.

	Start simulations		Full runs	
	Ice house	Dry land	Training	Competition
2004–2005 season	25	20	91	16
2005–2006 season				
Off-season	60	190		
In-season			92	18
Total	85	210	183	34

Note: The Olympic athlete undertook an additional six training runs plus two competition runs that are not included in the above table, as these occurred at the 2006 Winter Olympic Games.

2006 Torino Winter Olympic Games (Athlete B). These findings provide support to an aggressive talent identification and talent transfer approach that identifies successful senior athletes ($>$18 years old) from sports that have similar qualities believed to be important in the sport that the athletes are transferring to. Moreover, it corroborates the current concept that deliberate practice accumulated in many sports may be an alternative pathway to expertise (Baker, 2007; Coleman, 2007; Runco, 2007).

We created a supportive and aggressive but time-limited learning environment, led primarily by a world-class coach with previous Olympic medal success who thus knew what it would take for a high-performance programme to succeed at the elite level. The athletes had access to a team of sport scientists and practitioners on a daily basis to ensure an optimal daily training environment. We believe deliberate programming rather than deliberate practice was the key to this programme's success. Deliberate programming differs from deliberate practice because it encompasses other planned factors in addition to practicing skill. Deliberate programming allowed all athletes access to the best possible equipment, including sleds, speed suits and helmets, coaching, sports science support, and access to as many competitions as possible during this period. No athlete had to face the additional stress of financing any part of this project. We deliberately programmed the competition schedule during the Olympic year (2005–2006) by selecting four athletes to compete on the World Cup circuit. Australia had only qualified two places at each World Cup race; therefore, when two athletes were competing at a World Cup, the other two athletes were training at the competition venue for the following World Cup. This strategy took into account the athletes' limited sliding ability and track knowledge, and allowed all athletes to maximize training and the potential to achieve the best possible result in each World Cup to help Australia qualify an athlete for the 2006 Winter Olympic Games.

Although Athlete B was not one of the fastest upright 30-m runners in this talent identification and development programme, during the 2005–2006 World Cup season, she was one of the fastest pushers on the World Cup circuit (FIBT, 2007) and produced the best World Cup results in our programme, which supports the idea that a fast start time is a prerequisite for an excellent overall performance (Zanoletti et al., 2006). Conversely, Athlete D was one of the fastest 30-m sprinters in the group that transferred immediately to the push start where she was instantly one of the fastest pushers on the World Cup circuit (FIBT, 2007). However, Athlete D struggled with the driving component of the sport and could not translate her fast push into a good finish placing. This athlete had a serious crash at the end of the 2004–2005 season that could potentially have set back her confidence and consequently her driving progression. Therefore, the use of 30-m sprint time as a primary selection characteristic may have initially acted as an "filtering mechanism" to select "already fast" athletes, but other factors – creative thinking, decision making, attention, self-confidence, motor skills, and coach interaction (Williams & Reilly, 2000) – should also be considered for talent identification. This highlights that the selection of appropriate talent involves a multi-dimensional approach involving more than just physical performance (Abbott & Collins, 2004; Nieuwenhuis, 2002; Reilly et al., 2000; Staerck, 2003).

The superior performance of Athletes A, B, and C in comparison with the TID athletes may have been related to their surf life-saving beach flags sprint background. Beach flag events require competitors to race from a prone backwards starting position, pivot and sprint for about 30 m on the whistle command, and then dive to capture a flag or tube (often a short rubber hose piece) in the sand. There is always one less flag than the number of competitors in the race. The race is a knock-out competition where no times are recorded. Unlike track and field, where competitors race in a single lane on similar track conditions where minimal decision-making tactics are employed, beach sprinters constantly change their race tactics and strategies due to changing beach conditions, different competitors, and varying start and flag locations. There is also uncertainty in the nature of surf life-saving scheduling, so all competitors have to be prepared to compete at any time. Furthermore, these three athletes were also regular surfers. It is possible that the adaptability gained through both beach sprinting and surfing experience aided successful transfer and development in skeleton, where there is constant rescheduling due to weather, track conditions, substantial variability between beach courses, and with surfing the constantly changing conditions. That is, their ability to react to the moment rather than following a pre-determined plan may have heightened the athletes' ability to adapt to the unknown and to make the adjustments needed to succeed in the sliding sport of skeleton. This adaptability and multi-sport background may again provide an alternative pathway to expertise (Baker, 2007; Coleman, 2007; Runco, 2007) rather than just deliberate practice in the one specific sport (Ericsson et al., 1993).

Ericsson's deliberate practice theory requires modification, as deliberate practice in isolation may support the 10-year rule to attain expertise, but the talent development model created in support of skeleton practice in this study was used to enhance the rate of talent development and ultimately expertise. The main differences between the talent transfer model and Ericsson's deliberate practice doctrine (Ericsson et al., 1993) are summarized in Table IV. The original deliberate practice theory suggests that anyone can become an expert with acquired practice in that particular sport rather than any genetic predisposition, and this should give rise to an unlimited available talent pool (Ericsson et al., 1993). We primarily selected athletes based on their recorded 30-m sprint times, which not only limited the talent pool (to fast sprinters) but also favoured those individuals with prior sporting experience. All four successful athletes who represented Australia on the World Cup circuit had previously represented their state or country in other sports, again suggesting that prior sporting experience is preferential. Incidentally, the athlete who achieved World Championship qualification with only 10 weeks of sliding experience was crowned a World Champion in her previous sport 5 months earlier.

The methods employed in this talent identification and development study support the proposed talent transfer model (Table IV) as all athletes were over 18 years old, which supports late specialization in a sport, but they had accumulated at least 15 years' sporting experience in an array of sports. For this talent identification and development project, the developmental time frame was very short (14 months) and exposed all athletes to competition within 2 weeks of starting the sport and four athletes were competing against senior elite athletes (World Cup) within one sliding season. The deliberate practice theory does not support the need for competition to become an expert; rather, practice is the only way to achieve specialization (Ericsson et al., 1993). Recently, a concern has been raised about the lack of competition in the deliberate practice model (Starkes, 2007). A component of expertise is the athlete's ability to reliably perform the skill in a competitive setting, rather than excelling as a "practice player" (Starkes, 2007). This TID model used competition as an essential element for athlete development to enhance the ability to perform at the elite standard. Similarly, the idea that enjoyment is not an important factor in the deliberate practice model renders the model theoretically flawed (Helsen et al., 1998; Hodges and Starkes, 1996; Young and Salmela, 2002) and cannot be universally applied to the "sport model".

Table IV. Contrasting approaches of the acquisition of sporting expertise through talent transfer or deliberate practice (reprinted with permission from Jason Gulbin, Australian Institute of Sport – unpublished information).

	Talent transfer	Deliberate practice
Basis of talent	Innate abilities	Acquired by practice only
Available talent pool	Highly limited	Unlimited
Existing athletes	Can be "leap-frogged"	Cannot be "leap-frogged"
Prior sporting experience	Favoured	Not favoured
Developmental time	Short (e.g. 2–3 years)	Long (i.e. 10+ years)
Competition	Essential	Not considered
Specialization	Late	Early
Fast-tracking	Achievable	Not achievable
Enjoyment	Important	Not important

The women representing Australia in the 2005–2006 World Cup season were the most inexperienced skeleton athletes in the World Cup races, senior World Championships, and the Olympics Games. Yet these athletes attained finish places in World Cup events above athletes who had much more skeleton experience. According to the deliberate practice theory, the performance an individual attains is directly related to the volume of deliberate practice (Ericsson et al., 1993). This suggests it would be impossible for an athlete with less accumulated practice in a particular sport to fast-track or to perform at or above the level of individuals who started sport-specific deliberate practice earlier and maintained maximal levels of deliberate practice. Within two competitive seasons of deliberate practice, our athletes achieved top six rankings in World Cups and one individual competed at the Olympic Games, which suggests that fast-tracking and surpassing (leap-frogging) more experienced competitors is achievable with late specialization.

It is possible that the prioritized selection measure of 30-m sprint may have deselected the most talented skeleton athletes, therefore leading to a "false positive". Athletes were invited to the initial screening camp based on their 30-m sprint time, yet only one of the athletes who competed on the World Cup was selected on this selection measure. It is also conceivable that the most successful athletes in this programme were in fact not the better skeleton athletes for the long term. The early selections based on short development exposure to skeleton may have suited the early developers or quick learners; that is, they may simply have had the ability and capacity to take on the large amount of information given to them in a short period of time. With a greater amount of time, slow adapters may ultimately demonstrate comparable or better performances. Only time will tell whether the continuing sliders (A, B, and C) have the ability to achieve success in the long term.

In conclusion, this project prospectively monitored all aspects of the skeleton training and competition experiences of a Winter Olympian over a 14-month period, while also monitoring a number of other athletes recruited through a talent transfer programme. While the number of repetitions and completed number of runs in this programme over two seasons are actually closer to what most developmental athletes would do over three seasons (unpublished observations, Australian Institute of Sport), the 10-year deliberate practice theory is inconsistent with this evidential account of successful late specialization and rapid expert development. However, these findings support the idea that deliberate practice accumulated in many sports may be an alternative pathway to expertise. From the onset of this programme, all athletes were provided with high-quality coaching, technical, and sport science and sport medicine support to ensure that they fulfilled their potential (deliberate programming). It is interesting to note that within our TID cohort, the two most successful Australian athletes (Athletes A and B) were two of the best performers from the very first day on ice. Without deliberate programming, it is highly probable that Australia would not have qualified an athlete for the 2006 Winter Olympic Games.

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