Merging Athletic Development With Skill Acquisition: Developing Agility Using an Ecological Dynamics Approach

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ABSTRACT

Agility has commonly been regarded as a physical quality, and strength and conditioning practitioners have typically used a closed environment approach for developing agility. This closed environment approach involves the decoupling of perception and action, where actions are trained in isolation from perception. Previous studies have shown, however, that when perception or action is trained in isolation, behavior changes. Therefore, agility is complex and multifactorial in nature. Through ecological dynamics, specifically the principle of representative learning design, practitioners should design training tasks that align more closely with the demands of competition. Representative learning design ensures that perception and action remain coupled to promote greater transfer of performance from training to competition. Another key principle for agility task design is coadaptation, and this can be operationalized through manipulation of opposing players. With these 2 key principles, we offer examples of agility tasks in 3 team invasion sports including soccer, rugby union, and Australian rules football.

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INTRODUCTION

There have been numerous definitions of agility in the sports science literature, but a widely accepted definition is "a rapid whole-body movement with change of velocity or direction in response to a stimulus" (55). Agility is important for team invasion sports, including, but not limited to, Australian rules football, soccer, the rugby codes, American football, Gaelic football, and basketball. It is important to note, however, that agility is likely to be dependent on the demands of the task and may therefore be different for each sport. In soccer, a player may use a stepover to deceive their opponent to create space to cut into and a scoring opportunity. A stepover is a movement in soccer where the attacking player rolls their foot over the top of the ball to deceive the defender(s). This example of agility is unique to soccer, and an agility maneuver would look different in a different sport. Therefore, agility can be classified as a sport-specific quality (72). Even within sports, there can be variations of agility, depending on the task (73). For example, attacking agility in team sports typically involves movement (a change of direction and/or velocity) to create separation from opponents, whereas defending typically involves a movement to close space (73). In Gaelic football (a team invasion sport), a defender requires

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agility to move into the correct position to tackle or execute a block on an attacker.

In contrast, an attacker requires agility to avoid a defender to enable a shot or pass. Although there are common features of attacking and defending agility, expertise in one does not necessarily transfer to expertise in another (17,73). Agility is a complex quality that involves the coupling of perceptual information to guide actions (and vice versa; (25, 52)), and not simply the execution of a predetermined movement (73). Perception–action coupling can be defined as the relationship between an individual's perceptual and motor processes (47). To encapsulate the underlying features that contribute to agility, Young et al. (71) derived a model that broadly divided those features into 3 distinct categories including (a) cognitive factors, (b) physical factors, and (c) technical factors. Thus, agility is complex and multifactorial (40).

Spiteri et al. (57) created a framework to develop agility, which progressed from closed environments with no stimuli, to a closed environment with nonspecific stimuli (voice, whistle, light, cone), to an open environment with sport-specific stimuli. This paper will elaborate on the open end of the continuum and will discuss the development of agility in team sports using the key skill acquisition principle of representative learning design (RLD), a key feature of ecological dynamics (45). The importance of maintaining and developing a functional perception–action relationship in training tasks will be highlighted, along with the effect this has on transfer. In addition, the constraints-led approach will be recommended for practitioners to consider when designing agility training tasks to encourage transfer from the practice field to the competition arena (50). A glossary (Table) has been provided to aid practitioners' understanding while reading this paper.

LEARNING AGILITY TECHNIQUE

Ecological dynamics is a theoretical framework that can be used by practitioners to guide how they design and implement practice tasks (7). Ecological dynamics is a combination of 2 theoretical approaches including ecological psychology (24) and dynamical systems theory (4,35). Under this framework, athletes are considered complex adaptive systems composed of many interacting parts. Athletes interact with their environment (opponents, teammates, rules, playing surface, etc); they must continuously regulate their actions to achieve the task goal (14). Acquisition of movement coordination is typically non-linear (8,9), which suggests that it does not develop in a gradual or predictable way, but instead, athletes can experience sudden jumps and/or setbacks that can be difficult to explain or predict (7).

A key design principle within ecological dynamics is RLD (5,45). Through RLD, the task itself is designed in a such a way that it maintains the relationship between the information available to the learner in the environment (perception; e.g., the presence of opponents and the direction of force from an opponent during a tackle, communication from teammates relating to space that may be available for actions, the pitch conditions which can influence how a player passes a ball to a teammate) and the actions that the athlete executes in the presence of such information (action) (9). Chow et al. (9) defined perception as the search for specifying information used to guide action. RLD aligns with the training principle of specificity (21). Viewing agility through an ecological dynamics lens encourages practitioners to maintain this perception–action relationship to create representative practice tasks. RLD contains 2 key characteristics including (a) functionality, meaning that the information and constraints that a performer uses in training are representative of those that exist in the competition setting, and (b) action fidelity, which refers to the correlation between performance actions (e.g., passing, shooting, anticipation) in training and performance actions in competition, that is, the transfer of training to competition (46). Through RLD, the athlete practices the skill in an environment that is representative of the game and where the practice task includes similar sources of information and similar individual, task, and environmental constraints to those who would normally be experienced in competition (see the examples in Figure 1) (9). A simple alternative for practitioners could be to ask themselves (or the coaches and players with whom they are working) the question, "does practice look and feel like competition?" (51). A concept that captures the idea of RLD is that of a fish tank (23). A fish tank is a simplified ecosystem in the real world that preserves the fundamental components that an ocean contains such as rocks and sand at the seabed, seaweed, other fish, and most crucially, water. Applying this concept to training design for agility can help strengthen the performer-environment relationship, helping the athlete develop more functional solutions (29,67). The crucial constraints acting on a player in a team invasion game are opponents, rules, and the space in which they play. These components must be incorporated into training tasks to ensure the concept of RLD remains intact (45). For example, learning to shoot in basketball without defenders could potentially develop movement solutions that are ineffective when transferred to competition (26). However, a key consideration for coaches is to manage the relative difficulty of a practice task by managing the level of representativeness, because a highly representative task may exceed the challenge point for some players (32).

Renshaw et al. (52) proposed the game intensity index as a method of managing the density of players when creating representative practice tasks for team games. The game intensity index is a function of the playing area and the number of players within that area. This method can replicate the space available in a game, or the game intensity index can increase the demands on evasive qualities by reducing the space available to players. Incorporating these components into task design in

Table Glossary of skill acquisition terminology	
Term	**Meaning**
Action capabilities	Foundational movement capacities and general athleticism of an individual (51)
Action fidelity	Refers to the correlation between performance (e.g., actions) in competition and performance in training, that is, the transfer of training to competition (45)
(Skill) adaptability	A functional performer-environment relationship (3)
Affordance	Properties of the environment whose perceived meaning is the actions they both allow and invite for a performer (3)
Affordance landscape	Opportunities for action within a performance environment (3)
(Skill) attunement	Being perceptually sensitive to specifying information variables when performing a task (34)
Complex adaptive systems	A network of integrated subcomponents (parts of a body; players on a team) that interact to coordinate movement (52)
Constraints	Boundaries, limitations, or design features that influence how a performer can achieve a task goal (27)
Constraints-led approach	A practical framework that involves selectively manipulating constraints (individual, task, and environment) to achieve a desired learning outcome (51)
(Optimal) challenge point	The relative difficulty of a task that optimally challenges an individual to promote learning (28,32)
Ecological dynamics	A theoretical framework that considers the close coupling between the performer and their environment and which can be used by practitioners to guide how they design and implement practice tasks (7,50)
Emergent	Dynamic and functional movement solutions that naturally emerge because of the interacting constraints that impact on a given individual or team (7)
Functionality	The information and constraints that a performer uses in the competition setting (44)
Generality (of transfer)	When a practice task contains non-specifying information and will serve to develop a player's general capacities (strength, anticipation, balance, etc.) (7)
Intentionality	The objectives or desires of a player that influence the interaction between the player, the task, and the environment (7)
Nonlinear systems	Nonlinear systems do not develop predictably, but rather, they can experience sudden jumps, pauses, or setbacks in performance that can be difficult to predict (9,10)
Non-specifying (information)	Information in the environment that is of less value to the performer for regulating their behaviors (7)
Perception	The pick-up of information by a performer [*see below*] to guide their actions (9)
Perception–action coupling	The relationship between an individual's perceptual and motor processes (7)
Representative learning design	A principle that informs how coaches can design practice tasks so that those tasks replicate the information present in competition (5,45)
Representativeness	The extent to which a task "represents" the competitive environment (51)
Specificity (of transfer)	When a practice task contains specifying information that will help develop a player's perception–action couplings (7)
Specifying (information)	The key information needed to regulate behavior in sport (7,27)
Transfer	When prior experiences influence performance under a different set of conditions (25,33,54)

training can help to ensure that the constraints of competition are being replicated. Figure 1 details a sample agility progression for rugby union. Crucially, movement performance should be seen as a functional solution that emerges from the interaction of individual, task, and environmental constraints (9). Representative agility tasks can be created by sampling the constraints from the competition setting. For example, 1 v 1 practice tasks are more representative than a 1 v 0 practice task, and coaches therefore do not necessarily need to recreate the full version of the game to increase the representativeness of their practice tasks.

PERCEPTION–ACTION IN SPORT

Interactions in the sporting environment are guided by other participants (opponents and teammates) and other relevant constraints (line markings, target areas, etc.) (9). A small-sided game (SSG) illustrates a training activity where players must be attuned to relevant sources of information to appropriately regulate their actions to achieve a task goal. This can be a suitable environment in which to develop agility, because it replicates the sport-specific constraints present in competition, allowing players to learn to attune to the sources of information required to guide their actions (70). A SSG contains a ball, opponents, line markings, specific rules, and a scoring system that will help to educate players' intentions and attention, and players will then have an opportunity to calibrate their actions to solve the problems they face in competition (9). To illustrate the complexity of task design, we can look at the contrasting demands of SSG 1 and SSG 2 in Figure 1. By altering key task constraints, such as the number of players, the size of the pitch, or the rules, different behaviors may emerge. For example, an *extensive* SSG can lead to greater high-speed running demands in comparison to an *intensive* SSG (76). Here, an extensive SSG can be characterized by games of long duration (20+ minutes continuous), whereas an intensive SSG can be characterized by shorter bouts interspersed with rest intervals (e.g., 30 seconds work:30 seconds rest; (76)). Reducing time and space are 2 ways to increase the time demands on players by encouraging them to learn how to execute their skills under higher levels of defensive pressure (9). However, these alterations can also have a major impact on the physiologic demands of the task (for a full review (31)). To follow the previous example, extensive or continuous training bouts can increase the rating of perceived exertion and percentage of maximum heart rate in comparison to an intensive or intermittent SSG (31). Furthermore, reducing time and space can reduce peak velocities attained by players, indicating that there is a trade-off between the skill and physiological demands of a task (36). Therefore, practitioners should have a clear intention when designing a task (51).

The ability of a player to extract information from the surrounding environment to regulate actions toward a task goal is underpinned by the strength of their perception–action relationship (44). This is applicable to a winger in rugby union trying to score a try, or a striker in soccer creating space for a shot. Ensuring that this perception–action coupling is present during training is not only critical to enhance the strength of the relationship between an individual's perceptual and motor skills, it also helps to ensure that the movement strategies used in training match those movement strategies required in competition (44,46). Numerous studies across various contexts show that the movement strategies that performers use are altered depending on the nature of the available perceptual information (46,63). Pinder et al. (46) showed that in cricket, the use of ball projection machines (rather than an actual bowler) removes key sources of information (bowler's movements preball release) from the performance environment, which can significantly alter the timing of actions in cricket batting. Running technique has also been found to be altered in agility tasks, depending on whether the task was reactive or preplanned (61). During a preplanned side-step, participants were found to incorporate greater lateral movement toward their target before a planned step because they had already predetermined their running direction (65).

In contrast, during a reactive step where the participants responded to an actual person in an unpredictable situation, they had to keep their body

Figure 1. Sample task simplification progression of agility tasks in rugby union. To optimize transfer to competition, agility should be trained in settings representative of the competition environment (51).

square before the step to give themselves the best chance of redirection (65). These findings highlight that changes in the perceptual information will lead to changes in behavior (in this case, their agility maneuver). Therefore, if perceptual information in training is consistent with the perceptual information in competition, the actions in training are more likely to represent the actions required in competition (44).

Although action strategies change in response to different perceptual information, perceptual strategies can also be altered in response to different actions (24). When evaluating decision-making, researchers have typically used a video-based stimulus (22). The presented video is stopped at predefined moments and performers are asked to anticipate the outcome or select an action. A major concern with this experimental design is that decision-making may function differently depending on the action a performer can execute (38). This has been illustrated in soccer, where van Maarseveen et al. (64) found that players' performance in the video tests did not predict performance in small-sided games. Dicks et al. (15) also showed that goalkeepers altered their gaze behavior when different action responses were required. This shows that perception–action coupling is a loop as described by Gibson (1979), "we must perceive in order to move, but we must also move in order to perceive" (p. 223; (24)).

These findings, in particular, highlight a major limitation with preplanned change of direction speed (CODS) practice tasks in the intentionality of the performer, which shapes actions and perceptions (7). In preplanned CODS tasks, as an athlete moves toward a cone or line to execute a step or cutting maneuver, their sole intention is to follow the instructions of the task, rather than to attune to informational constraints such as an opponent's movements, or space available in the playing area (16). This is in contrast to an agility task or a game situation where an athlete's intention generally involves moving in anticipation or in response to an unpredictable stimulus to achieve the task goal. This interaction between intentions, perceptions, and actions will determine the affordance landscape for the athlete (7,9). An affordance can be defined as an opportunity for action where an environment is perceived by the performer in possible actions at a given time and in a given context (20). An environment may afford a range of behaviors for a player, and the affordances that a player identifies are a product of the actions a player can perform (i.e., affordances are specific to the individual) (20). With every step an athlete makes, some affordances disappear, some are maintained, and some new affordances are presented. Importantly, an agility solution will emerge based on (a) the athlete's level of attunement to the key information in the performance environment (perception), (b) the athlete's action capabilities (action), and (c) their intentions (7). In an agility context (e.g., 1 v 1 scenario), attackers of differing action capabilities may choose different strategies: A player with a high maximum velocity may try to outrun the defender, whereas a player with quick CODS capabilities may try to sidestep the defender.

TRANSFER: SPECIFICITY VERSUS GENERALITY

The aim for practitioners is to create practice tasks that enable players to transfer what they have learned in training to their competition performance. From an ecological dynamics perspective, transfer occurs on a spectrum of generality to specificity (7). A greater amount of specifying information will typically lead to a greater specificity of transfer, whereas less specific information in a practice task will tend to provide more general transfer (54). Although specificity of transfer is an important consideration for practitioners in enhancing competition performance, there are occasions in which generality of transfer can be beneficial (7). For instance, it has been shown that expert athletes participate in various sports compared with nonexperts during their developmental years (14). This increased diversity of early sporting experiences is believed to lead to a higher level of sports performance, enhanced fitness and health in young athletes, and a higher enjoyment of sport (7,11,12). This supports the idea of early diversification enhancing athletes' adaptive capabilities (3,14).

A contemporary example of this is the athletic skills model (ASM) (66). This model encourages individuals to experience a variety of learning environments in which they explore a range of functional movement solutions through development of physiologic and psychological skills and capacities (69). In 2016, the Amsterdamsche Football Club Ajax soccer club created an athletic skills track to implement the principles of the athletic skills model and to support the holistic development of their youth soccer players (69). Some of the athletic skills track components included movement skill areas with ropes, boxes, and trampolines, and a test area for a range of agility, balance, speed, and strength tests. As of 2012, the athletic skills model had been in use for 7 years, and youth trainers reported enhanced performance of youth teams at national and international levels, and a decrease in injuries (69). Another contemporary example of general transfer, and an activity that uses a similar concept to the athletic skills model, is the use of parkour as a donor sport for athletic development in youth team sports (59). A parkour training environment can develop many physical qualities required in team sports, such as anticipation, balance, and coordination, which are important contributors to agility (55,59). This can be particularly useful at the developmental level to break the monotony of sport-specific training, and to help prevent overuse injuries because of repeating the same movement patterns (54). Parkour is an acrobatic sport where participants develop their action capabilities relative to their perception–action skills to maneuver through environmental obstacles in a creative manner (2). This general development of action capabilities can aid sport-specific performance, for example, a player could enhance their stepover maneuver in soccer through the stepping and reaching aspects of parkour (59). Strength training can also support general and specific skills that underpin athletic performance through enhanced force production and attenuation (19,60).

Similar to the ASM and parkour, CODS can aid generality of transfer and there are scenarios when preplanned CODS training can be valuable (6,16). As the loading in CODS drills can be controlled through monitoring of entry speed into a cut, the angle of a cut, and the direction of a cut (left or right), CODS drills can be more useful to develop physical capacities in performers in comparison to agility tasks (16). The nonlinear nature of an athlete's interaction with the environment within a representative setting can mean that optimally loading an athlete's physical capacities can be difficult to achieve. Furthermore, a CODS training program can be useful in development settings, and rehabilitation settings when an athlete is looking to regain movement stability after an injury (6). Multidirectional movement is a key stage in rehabilitating injured soccer players, aiming to complete preplanned multidirectional movements of increasing speed and complexity (6). CODS training can be suitable when transfer and learning are not direct priorities (56), but as mentioned, a major limitation with CODS training is that it changes the athlete's perceptions and intentions, which can then lead to different perceptions and actions to those seen/required in competition (46,62).

Furthermore, prolonged practice using CODS training is likely to lead to perception–action couplings that are not well aligned to those required for successful performance in competition (7). Long-term exposure to representative agility tasks is therefore required to help the athlete to attune to specifying information that is better suited to guiding the actions required in competition (40). This point aligns with the agility development continuum previously mentioned, which ranges from closed environments to open environments (41,57). There are times when practitioners should be general with training, and specifying information of competition does not need to be present. Alternatively, there are times when specificity of transfer is a key focus for a coach and where training tasks should therefore be designed to provide athletes with specifying information. Practitioners should consider a mixed methods approach that integrates the varied approaches where general and specific training are combined within the same session. Designing suitable open-environment tasks to develop agility will be the focus of the next section.

AGILITY TASK DESIGN USING THE CONSTRAINTS-LED APPROACH

The constraints-led approach (CLA; Figure 2) is an applied framework that allows practitioners to design and implement learning environments by manipulating constraints (9). The CLA is based on Karl Newell's (1986) model of interacting constraints, situated within the perceptual-motor landscape of the individual (9). Constraints act as boundaries that guide how learners self-organize to generate functional movement solutions in any given goal-directed task (47). The CLA considers skill acquisition as skill adaptability or attunement (3), highlighting the importance of practitioners designing practice environments that encourage athletes to adapt. The nonlinear nature of an athlete's interaction with the environment makes player performance within any given task difficult to predict. This highlights that coaches should avoid prescribing a specific or "ideal" movement solution for athletes (37) and instead coaches should create practice tasks that enable athletes to learn to adapt to changing constraints (53). Through the CLA, the learner is at the center of the entire process and should be allowed to develop individual movement solutions within the environment in which they operate (30). Coaches have used the CLA to aid player preparation in several performance and development contexts, including Australian rules football (62,67,68), rugby union (39), American football (70), field hockey (51), and soccer (18,42,61).

Successful performance implies that the individual can achieve the intended goals of a given task (e.g., the ability to complete a jump shot in basketball, despite being pressurized by 2 defenders) (26,45). The key to skill acquisition is for the individual to learn to adapt to the constraints that affect them at any given moment (3). Newell's (1986) model of constraints characterizes individual, task, and environmental constraints as the variables that influence behavior, and so identifying the key constraints acting on an athlete during competition will assist practitioners in designing practice tasks that enable athletes to find functional movement solutions to the problems they face in competition (47). In other words, practitioners can design representative tasks to ensure practice resembles the demands of competition (53,67).

An important feature of the CLA is the notion of constraining to afford where the coach manipulates specific constraints in the practice task to invite, rather than force, players to explore the desired movement solutions (51). For example, Young and Rogers (75) used an SSG to train the agility of Australian rules football players by limiting players' ball disposals (task constraint) to require them to perform an evasive action (75). This is an example of constraining to constrain action, where players are overconstrained to a point where they *have to* perform an evasive action, rather than constraining to afford action, where players are invited to *choose* to perform an evasive action due to the presence of specific affordances that provide opportunities for that action to naturally emerge (51). Another key principle in team sports is co-adaptation, which highlights the

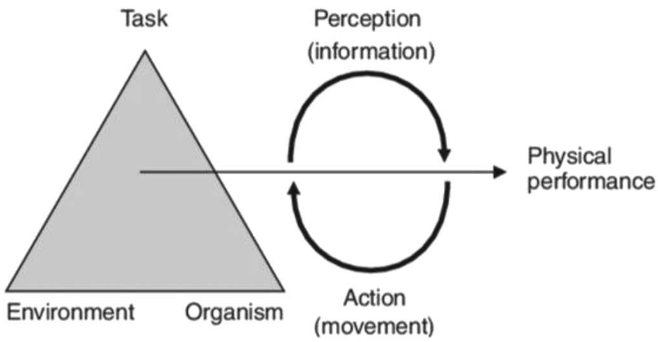


Figure 2. Constraints-led approach (13).

emergence of continuous interactions between players (opponents and teammates) as they co-adapt to each other's movements (51). This principle can be operationalized in training tasks by manipulating opposition such as constraining the defender(s) to promote a behavior change in the attacker(s), or vice versa. Incorporating the principles of RLD and co-adaptation, coaches can design agility training tasks that will encourage players to attune to key information sources to promote transfer to the competition setting.

When designing agility tasks for specific sports, we propose a 3-step model to help practitioners to incorporate RLD into their practice sessions. This process can be summarized as sampling the competition demands and monitoring changes in performance. There are numerous aspects that a practitioner must consider when implementing RLD, including the appropriate level of representativeness, considerations regarding the tactical aspects of the game, ensuring that the practice tasks address a specific area of need for the given team or player, and the periodization of RLD throughout a season.

Step 1: performance analysis of the sport. A critical component of designing representative tasks in training is establishing the competition environment's demands (63). For example, Rayner et al. (48) analyzed in-game 1 v 1 agility events within the Australian Football League to identify the movement and cognitive demands of Australian rules football. In soccer, Ade et al. (1) analyzed movement patterns in relation to technical and tactical actions to aid the development of position specific tasks that reflected the demands of the game. In both sports, agility maneuvers existed in and out of possession, and there were differences in the agility requirements of attackers and defenders. These studies provide a strong foundation for practitioners to design tasks that accurately resemble the competitive environment (63). A performance analysis (identification of specific constraints and actions to create a representative task) can be combined with a needs analysis, which involves identification of the biomechanical characteristics, physiologic demands, and injury epidemiology of the sport (49). Combining a performance and needs analysis will give practitioners a comprehensive understanding of the sport they are working in and will equip them to design agility tasks.

Step 2: sampling the game demands. The constraints of the competition setting should be sampled from the information gathered in step 1 to ensure that action fidelity and functionality are maintained in the practice task (45,58). A key consideration when implementing RLD is to determine the level of representativeness of the practice task to ensure that the demands of the task are suitable for the needs and capabilities of the performers (51). To understand the current skill level of athletes, the 2-stage model of learning (coordination and adaptation) created by Renshaw and Chow (2019) can assist practitioners when designing RLD tasks (51). Although age, playing experience, and competition level may be used to determine an athlete's skill level, in sports with a wide variety of skills, it is still necessary for practitioners to analyze each athlete's performance to identify where they sit on the skill level continuum. For example, an elite level attacker in football may possess poor defensive agility skills, and vice-versa.

In the challenge-based framework outlined by Hodges and Lohse (32); see also Ref. (28), there are different types of practice, depending on the goals of a session or task (32). *Practice-to-learn* involves designing challenging environments to elicit improvement. When the goal is learning, practitioners should design practice that is at least moderately difficult for the individual (32). *Practice-to-transfer* involves creating meaningful difficulties that simulate the behaviors required in competition. This stage is where RLD should be most prominent, to ensure functionality and action fidelity within the task (45). Finally, *practice-to-maintain* involves tasks that provide opportunities for athletes to succeed and to enhance player engagement, motivation, and confidence to perform.

Periodization considerations can occur over micro and macrocycles (43). For example, the training focus of an elite football team may change over a week leading up to a game. Three days out from game day (match day −3), training may be focused on skill learning and contain greater levels of game representativeness. However, the day before a game (match day −1), the training aim shifts to ensuring players are ready to perform on match day. On a macrocycle level, an amateur team may spend most of their preseason focused on the development of stable coordination patterns, whereas a higher skilled team may use that period of training to focus on skill learning (43).

The combination of the factors outlined here highlight that practice design is highly specific and needs to be individualized. For optimal results, "copy-and-paste" design of practice does not work. See below for in-depth examples.

Step 3: monitor the response. When a practitioner has considered the demands of the sport and the level of athlete(s) with whom they are working, the final step involves monitoring the response of the athletes to the training intervention. In line with the ecological approach to the design of training, the means of assessment must be ecologically valid so the assessment captures the behavior of a given athlete in a competitive environment (61). A strength and conditioning practitioner should work closely with the performance analyst to identify if the intervention affects competition. Is the athlete attempting more evasive maneuvres in games? When performing agility maneuvres in competition, is the player retaining possession of the ball more often? Is the player able to demonstrate suitable levels of agility in all situations? Questions such as these support an ecologically valid evaluation of the response from a training intervention and provide information on how practitioners can progress (or regress) their training interventions moving forward (63).

EXAMPLE 1: SOCCER

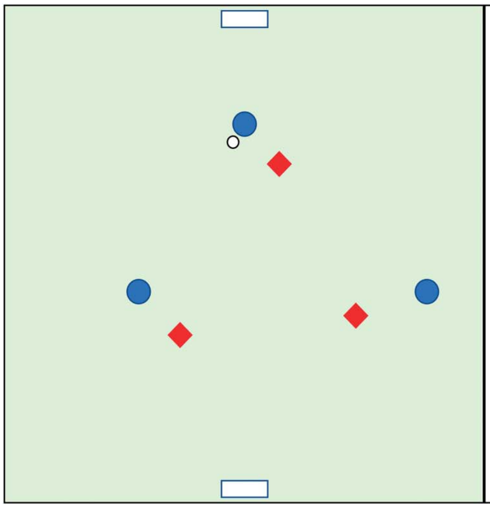
The game intensity index described by Chow et al. (8); see also Ref. (52) can be manipulated to encourage evasion in a small-sided soccer game in a number of ways. By creating a playing area that has a low game intensity index (i.e., reduced space per player), attackers are more likely to be confronted by an opposition player, thereby encouraging more evasive actions from the attackers. However, if players are inexperienced in evasive maneuvres, a more suitable option may be to create a game with a higher game intensity index (greater space per player) to encourage evasion in a "safe but uncertain" environment (39). Taking the skill level of the group into consideration when designing training tasks can help ensure that coaches design appropriately challenging tasks (28,32).

To promote agility actions in a small-sided soccer game with developmental athletes, one solution could be to design a 3 v 3 game with a small goal at each end (Figure 3). The smaller goal is aimed at discouraging long range shooting to encourage the attacking team to move the ball closer to the goal before shooting. The game intensity index could be higher (more space per player) than a full game to ensure players have space to execute agility maneuvres. A further task constraint could be placed on the defending team where each defender can only tackle one attacker. Therefore, whenever an attacker gets the ball, he/she has only one defender to evade and lots of space to do so. These conditions should promote evasion attempts in the game.

EXAMPLE 2: RUGBY UNION

As highlighted earlier, transfer exists from general to specific (7,54). From an ecological dynamics point of view, the perception–action relationship transfers from a practice task to the competitive environment when the constraints of the practice task are aligned with those of the normal competition setting (51). To enhance agility for rugby union, a small-sided game of 7 v 7 touch with 2 floating defenders (Figure 4) could be played in an area with a high game intensity index to encourage evasive actions. As the defending team have an overload, the attacking team will find it difficult to create and overlap anywhere on the pitch. Therefore, to break the line of defense, an attacking player must evade their opponent.

Further constraints can be placed on the defending team by creating a rule where



Playing group: U17 girls academy

Training aim: Practice to Learn

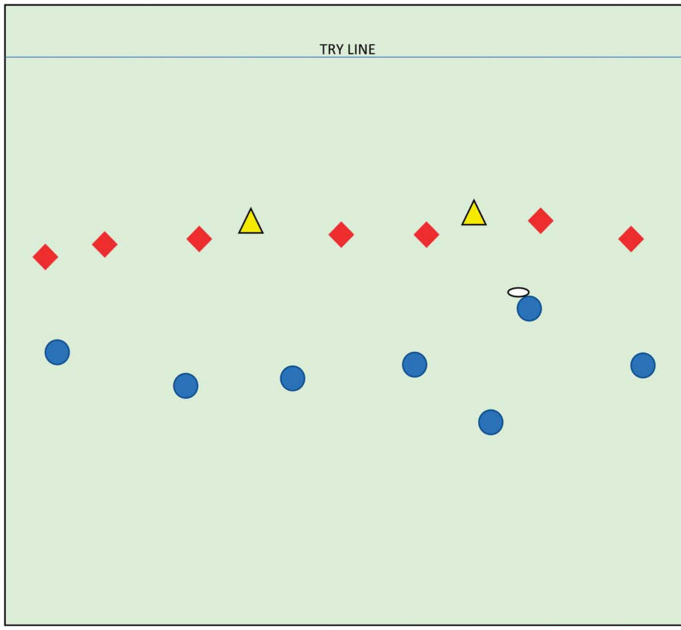
Description: Each player has a direct opponent, and players can only tackle their direct opponent. This will provide opportunities for attacking players to evade their direct opponent. Games are played on an interval basis, 30s play: 30s rest (Intensive).

Constraints manipulated: Pitch size, rules and scoring system (big goals vs small goals).

Dimensions: 50m x 42m (GII = 350m²)

Progressions: To enhance game representativeness, defenders can be allowed to dispossess any attacker. In addition to the time-based intervals, teams can play to a target score (first to five). An extra defender (+1) can be added in to enhance the challenge for attacking team. The goal size can be increased to encourage defenders to be close to their opponent, so the attacker does not have room to shoot. Goalkeepers can also be added.

Figure 3. Soccer agility 3v3 small-sided game.



Playing group: Senior men's XV semi-pro

Training aim: Practice to transfer

Description: 7v7 (+2). The two floating defenders are always defending – when there is a turnover they switch to whatever team loses possession.

Constraints manipulated: Pitch size and rules.

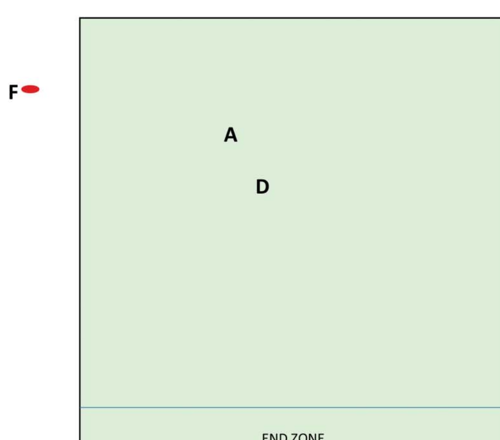
Dimensions: 75m x 40m (GII = 234m²)

Progressions: Depending on the periodization structure, the game can be adapted for full contact. The pitch size (and GII) can be reduced. Teams can be altered to 8v8. Kicking can be incorporated to encourage players to look behind the defense and out wide.

Figure 4. Rugby agility small-sided game example.

all players must be on the front line of the defense. However, from a rugby union perspective, "touch" games where defenders tackle the ball carrier by placing one or 2 hands on the ball carrier will have reduced transfer to the game. Therefore, agility training with maximum transfer in rugby union only occurs during "live" training games, and ball carriers are subject to the same informational constraints as competition, specifically the body shapes and positions of a defender trying to bring them to ground. This could be a simple progression in this task where instead of a two-hand touch to stop the attacker, defenders must tackle the opposition player to ground. To complement this constraint, the pitch area could be reduced to promote the opportunity to tackle. These progressions will enhance representativeness and transfer. However, it is important to note that including full contact training brings an added injury risk, and it is necessary to appropriately periodize training (21,43). There may be certain times during the training week where "touch" games are more suitable from a collision load viewpoint, providing "enough" representativeness to satisfy the session intention.

To highlight the interacting nature of constraints, this defender progression (touch to full contact) will affect the emergent behaviors of the attackers: With less space, the capability of the



Playing group: AFLW

Training aim: Practice to maintain

Description: Australian rules football agility RLD example. Attacker (A) must receive the ball of the feeder (F), and evade defender (D), and move into the endzone. F changes position around the outside of the square after each repetition, ensuring variability. Players can rotate roles after 3 reps or a set time.

Constraints manipulated: Pitch size, rules and player numbers.

Dimensions: 30m x 15m (GII = 225m²)

Progressions: If the challenge is too difficult for the Attacker, the Defender can be forced to start from a compromised position, such as face down, or touching a cone on the sideline. This will give the attacker more time and space to evade.

Figure 5. Australian rules football agility representative learning design example.

attackers to evade the defenders will become more challenging. Depending on the skill level of the attackers, this challenge may exceed their capabilities. If the aim of the task is to provide defenders with opportunities to execute tackles, then this progression is likely to be suitable. However, if the aim is to minimize collision injury risk and give attackers the opportunity to explore new evasive techniques (29), then these progressions may not be suitable. Session intention guides session design. As mentioned, being clear on session intention is critical for practitioners.

EXAMPLE 3: AUSTRALIAN RULES FOOTBALL

A challenge for attacking players in Australian rules football is the 360° nature of the sport with over half of 1 v 1 agility scenarios in the Australian football league occurring with the defender to the side or behind the attacker (48). This presents a different challenge for both attackers and defenders, compared with when the defender is in front of the attacker, with different movement demands placed on attackers and defenders (48).

A representative task to train this scenario is a 1 v 1 game in a reduced playing space, with a relatively high game intensity index to allow space for the attacker to evade. As shown in Figure 5, the attacking player (A) must receive the ball from the feeder (F), then evade the defender (D), and run the ball over a predetermined end line. A key principle of this game will be the use of repetition without repetition (4), ensuring that players are always adapting to the changing demands of the task (59). This can be incorporated into the task by varying the starting position of each player, rotating personnel with each repetition, or changing how the attacking player receives the ball.

PRACTICAL APPLICATIONS

Agility is a multifactorial and complex skill (40). The traditional method of developing agility uses a closed environment where the movements are performed in decontextualized settings and trained in isolation (72). Although this can sometimes be useful during a player's development, this paper discusses developing agility through RLD, which aims to maintain representative information-movement couplings in practice tasks (45). When perceptual information in training simulates the competitive environment, the emergent actions are more likely to be consistent with those used in competition (45). Long-term exposure to representative tasks in training is needed to help athletes become more attuned to important information sources in competition (71,74). The CLA approach is a method to operationalize RLD, helping to ensure the preservation of perception–action coupling and the transfer of training to competition (45); however, further empirical evidence is required to investigate the implementation of the CLA to develop agility in the sporting domain.

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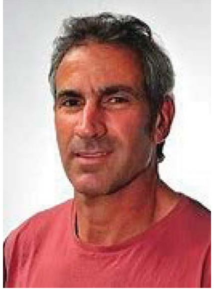

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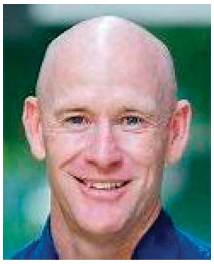

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