Volume 27, Number 4, pages 86–92

**Keywords:** visual training; rugby football

# Conditioning the Visual System: A Practical Perspective on Visual Conditioning in Rugby Football

Rudi Meir, MA, CSCS
Southern Cross University, Lismore, New South Wales, Australia

## summary

Most team sports spend a considerable amount of time devoted to the physical and skill development of players. Fundamental to this process is the involvement of the visual system, and yet rarely do we hear of this quality being catered for within the strength and conditioning program. This article outlines some of the concepts associated with visual training as applied in the sports conditioning program at Gloucester Rugby Football Club in England.

The ability of players to catch and pass the ball (i.e., handling skills) and to advance it beyond the opposing team's defensive line is fundamental to the sports of rugby union and rugby league. Not surprisingly, given the intensity of these sports and the aggressive defensive play of defending teams, players with the ball regularly lose possession, often because of poor judgements about when to pass to a teammate. During training, these errors can reduce the intensity of practice; during play, they can result in players becoming fatigued more rapidly because of the increased defensive work that comes with loss of possession. Part of this process relates to the visual system and the ability of the player in possession to quickly sight the target while under pressure. As a result, a significant amount of time at training in these sports is spent on improving the players' handling skills while simulating the fatigue and conditions experienced during play. Naturally, coaches in all sports are constantly searching for the training technique or strategy that will further enhance their athletes' performances and give them a competitive edge. More recently, sports optometrists have taken their expertise and skill in routine eye screening and applied it to the development of various forms of visual training that are intended to help athletes improve their performance by improving their basic visual functions (e.g., tracking, depth perception, and acuity; 2). This article outlines some of the concepts associated with visual training as applied in the sports conditioning program at Gloucester Rugby Football Club in England, which competes in the national professional competition.

## The Visual System

The visual system is linked to the proprioceptive centers of the brain. These centers control awareness of the body's position in space, which is obviously very important in a sport such as rugby union. In fact, approximately 20% of the optic nerve's fibers go indirectly to the brain centers that regulate and control balance (12). This connection can be easily demonstrated by simply standing on 1 foot with your eyes open then repeating this with your eyes closed. Note the movement in your support leg's ankle (9).

The visual and proprioceptive systems provide the athlete—or, more precisely, the central nervous system—with important information about what is happening in his or her external and internal environments. The central nervous system then takes this information and makes sense of it. This might include important information about the location of teammates, the speed and direc-

tion at which they may be moving, where their own bodies may be in space, and where their hands or feet may be in relation to an oncoming ball (1). The athlete then takes this information and interprets it in a way that, based on experience and learning, allows him or her to respond in an appropriate way. The visual system is the major sensory system providing this information, with this visual detail dominating the information provided by the other sensory systems (i.e., the brain will always treat the visual information as correct in the event of discrepancy between the eyes and other sensory-system feedback) (9, 12). Movement (kinethesis)—which is controlled by muscle, joint, and cutaneous receptors—and balance control—which is provided by mechanisms within the inner ear—are the most important forms of nonvisual perceptual information (1).

## Visual Fitness in Sports

In all fast-moving ball games where the situation is changing constantly, a high demand is placed on the participants to process information about their environment (4). In these sports, the ability to quickly and accurately use perceptual skills such as pattern recognition and anticipation play an important role in expert performance, which tends to be superior to that of the novice performer (3). The skilled performer has been described as one who (a) can select the appropriate course of action given the match situation; (b) reacts rapidly and appears to have all the time in the world; (c) has the ability to read the game quickly, recognizing situations and patterns of play and responding in an appropriate way; (d) can adapt his or her play to suit the conditions; (e) can produce both effective and efficient movements; and (f) can get the job done, fulfilling the task objectives (1).

Vision affects coaching practice and performance (7). The eyes are the major sensory system through which perceptual information is derived (1). Research has shown that highly skilled athletes have better visual abilities than do nonplayers in sports that are visually challenging (5). However, athletes do not need to have 20/20 vision (the expression of normal visual acuity used in the wider population) to compete at the elite level in sports. Some athletes may have reduced acuity in 1 or both eyes. In fact, some high-level performers may have sight in only 1 eye (e.g., Barrie McDermott, who is an England rugby league international and professional player with the English Super League team, the Leeds Rhinos).

Because eyes convey an estimated 80% of the information processed by athletes in sports, they are a vital part of the total athletic apparatus (4). This is particularly true of sports involving a ball; therefore, vision plays an important role in rugby union. This is often reflected in comments heard by coaches referring to players who have good "vision" or "great hands and ball awareness." Such intuitive comments are supported by research showing that most elite-level athletes possess not only great athletic skill but also great visual skills. However, some disagreement exists within the literature about the effectiveness of visual-fitness training to enhance performance. Abernathy and Wood (2, p. 204) point out 3 basic assumptions that would need to hold true for a generalized visual-training program to be effective: (a) that vision is directly related to sport performance and that this might imply an athlete would benefit from having supranormal vision as compared with subnormal vision, which would be detrimental; (b) that visual attributes associated with sports can be trained; and (c) that improved vision would translate to improved sports performance. According to Abernathy and Wood (2), if just 1 of these assumptions is not correct, then a generalized visual-training program would not benefit sports performance.

Although it is not new for athletes to undertake generalized visual training, as developed by optometrists, it appears that this approach for the athlete is ineffective (3). In their review of the literature, Abernathy and Wood (2) conclude that:

> increasingly the consensus is that expert and novice athletes are not characterized by differences in basic visual function. Rather the expert's advantage appears to be perceptual, related not to basic visual function but to how domain-specific visual information is interpreted and used to guide action (p. 204).

Their own research, which assessed the effectiveness of 2 generalized visual-training programs (i.e., Eyerobics and the Sports Vision program by Revien and Gabor [10]) on tennis forehand accuracy, found no benefit associated with this sort of program. However, these programs do not conform to the principal of specificity—one of the cornerstones of any sports training program—because they do not place the visual system and the individual under the same visual and physical demands as individuals who are experienced in the sport training or competition environments. This may, in part, explain why these generalized visual-training methods did not find improvement in sport performance.

Strong evidence in the literature indicates that the differences in expert and novice performance are related to pattern recognition (e.g., the ability to "read" play or to detect the type of pitch that is about to be delivered) and anticipation (1, 9). As a result, researchers have argued that improving basic visual function is unlikely to automatically lead to superior performance (2). Yet other researchers have reported that visual-fitness training can improve eye-movement skills, focusing skills, peripheral visual awareness, and visual-perceptual skills, all of which can carry over onto the field of play (5, 12).

**Table**
**Definition of Selected Visual Terms Relevant to Sports (1, 2, 7, 9, 12)**

| | |
|---|---|
| **Accommodation** | The ability to adjust the point of focus as objects (e.g., a ball) move (nearer) toward or (farther) away from the athlete. |
| **Acuity** | The ability to discriminate and resolve fine detail in an object. Static acuity is the ability to see a certain level of detail in a stationary object and is typically measured by the Snellen acuity scale. If a person can read the 20/20 line on the Snellen chart, he or she is considered to have normal visual acuity (i.e., good static visual acuity). Dynamic acuity is the ability to resolve detail in moving objects. |
| **Color vision** | The ability to discriminate differences in color (e.g., the ability to rapidly identify a teammate in the peripheral vision by uniform color). Objects with low contrast against the background will be more difficult to see than are objects with a higher contrast. |
| **Depth perception** | The ability of a person to accurately judge the distance between him- or herself and another object (e.g., a ball) in his or her surroundings. |
| **Dominance** | Dominance of 1 eye over the other. We all have a dominant eye, which processes and transmits information to the brain a few milliseconds faster than the subordinate eye. The dominant eye also guides the movement and fixation of the other eye. |
| **Fixation** | Without a conscious effort to attend to something, our eyes will constantly move throughout the visual field. Fixation occurs when an object attracts our visual attention and we focus both eyes on it. |
| **Peripheral vision** | The ability of a person to detect objects in his or her vision away from fixation. Wilson and Falkel (12) report that because of anatomical limitations peripheral vision cannot be trained. However, peripheral awareness can be trained, thereby increasing the speed and accuracy at which objects can be identified. |
| **Speed of recognition** | The ability to rapidly process information from the environment and use it in decision making, movement preparation, and skill execution. |
| **Tracking** | The ability of the eyes to track an object from one point to another. |
| **Vergence** | The ability to maintain fixation on objects as they move toward or away from the athlete. The eyes converge when viewing objects that are close and diverge when viewing more distant objects. |

Research involving elite female hockey players used a combination of visual-skills training—which consisted of a routine of eye exercises designed to improve visual accommodation, acuity, convergence, depth perception, peripheral vision, and speed of recognition (see the Table for definitions)—and vision-awareness coaching—which emphasized correct stick technique, use of the eyes, and body position in relation to the ball, so that players could better see the ball coming toward them or shoot the ball—to enhance player skill (5). This research found that using both visual-skills training and vision-awareness coaching produced a significant improvement in hockey-skill execution when compared with using visual-skills training only. However, a visual-skills training program or a vision-awareness program alone does not appear to produce improvement in hockey skills in elite players.

## Visual Training: A Rationale for Its Consideration in Strength and Conditioning

A basic understanding of the limits of the visual system will potentially allow strength and conditioning coaches to design and implement visual-skills activities within their normal training program. By understanding the visual demands of a sport such as rugby league or rugby union—or, for that matter, any of the ball sports—athletes may be able to reduce visual errors that might negatively affect handling and decision-making skills (7). Most rugby players would never go into a game without having practiced their skills and developed their strength and conditioning to the optimal level. The same should hold true for the individual's visual system, that is, it should be trained just like every other aspect of preparation for competition.

The eye is an amazing piece of anatomical engineering. Each eye has 6 extraocular muscles that attach it to the eye socket. These muscles are designed to work individually or in combination to produce all the different movements of the eye, termed *positions of gaze*. Sometimes they work in synergy with one another, other times they may work in opposition to produce a specific eye movement. All these muscles are similar to skeletal muscle in that they adapt to the stresses and

demands placed on them (i.e., they adapt to exercise training) (12). Three other muscles are involved: 1 controls focus and 2 control the size of the pupil to allow more or less light into the eye. These latter 2 muscles are not voluntary and therefore cannot be influenced by visual-fitness training (12).

Most strength and conditioning coaches may assume their athletes have 20/20 vision and nothing more is needed in terms of training in order to compete effectively in their chosen sport. Yet few, if any, athletes are required to undertake some form of basic screening, and even fewer are exposed to any sort of training to enhance the visual system. In fact, this is probably true at the highest levels of many sports, including rugby league and rugby union. Wilson and Falkel (12) report that although static visual acuity can be corrected, it cannot be improved with training. On the other hand, dynamic acuity, which is the ability to resolve a target when relative motion is between the observer and the target (8)—obviously very important in most sport activities—can be improved with training. This is supported by a number of studies that have shown improvements with training in commonly measured visual functions (e.g., foveal [central] vision [6], dynamic acuity [8], and accommodation [11]).

According to Wilson and Falkel (12), the visual system is like any other motor system within the body: it can be trained and improved by "exercise." The visual system will respond to overload and progressive increases in demand just like the neuromuscular and cardiovascular systems will respond to training. Athletes may benefit from visual-fitness training by improving their eye-movement skills, focusing skills, peripheral visual awareness, and visual-perceptual skills (12). The goal here is not to improve vision per se or strengthen the eye muscles but rather to enhance the speed, coordination, and endurance of eye movement. For example, during a game a player will need speed and accuracy of eye movement in superior gaze while fixating on a "high" ball as it moves in space, thus allowing him or her to react rapidly and precisely to get into a position to catch the ball.

## Applying Visual-Fitness Concepts to Rugby Football Training

By using the concepts and research presented in the previous sections, consideration was given to implementing a form of visual training into the normal training and preparation of players at Gloucester Rugby Football Club. The catalyst for this was the identification of 2 common problems that the Club's coaching staff attributed to execution of passing and catching a ball during training and play. Players often simply failed to (a) identify where their target was when passing a ball to a teammate or (b) look toward the ball when receiving a pass from a teammate. Naturally, a player must have a skill set in the execution of passing and receiving a rugby ball, just as with all ball sports. During training and play, a passing or receiving player must also contend with an enormous amount of information related to his domain, which may easily influence his ability to effectively pass or receive the ball. However, according to the literature, there is an intuitive logic to developing activities that can encourage players to routinely focus on these fundamental elements of skill execution and might reduce the incidence of handling errors seen not only during competition but also in training.

Therefore, this article focused on 3 basic aspects of visual motor skill identified by Wilson and Falkel (12): vergence, focusing, and tracking. These were selected with the belief that if players could locate, fixate, and focus rapidly on a target (e.g., a support player's hands or an oncoming ball), they would be less likely to produce handling errors during training and play. A novel aspect of this training was the introduction of a plastic surgical eye patch placed over 1 eye and used in a wide range of training drills that required players to pass or catch a ball. This simple aid encouraged players to turn their heads and shoulders toward their target, a basic body-positioning skill that was deemed to be responsible for many of the handling errors seen in training and competition. It also forced players to fixate more directly on the ball in order to catch it or pass to a target effectively. For example, if patching the left eye when conducting passing drills from right to left, the passer would need to turn his head and shoulders in a more deliberate way to allow him or her to see his target. Eye patches were typically introduced in basic-skill drills used in the early part of training sessions. Players would first execute selected drills without the patch, then complete the drill with the patch on 1 eye and then the other, and finally perform without the patch again. Players reported being able to more easily detect and pick up the ball in their field of vision after removing the patch. This may be an example of the acute influence of "loading" the visual system referred to by Wilson and Falkel (12).

Drills may also focus on patching only the dominant eye. We all have a dominant eye that transmits information to the brain a few milliseconds faster than the other. The dominant eye also guides the movement and fixation of the subordinate eye. From a handling perspective, it is important to allow both eyes to clearly view a passed ball at all times, hence the emphasis in skills drills on turning the head to see the flight of a ball passed between players. Determining which of your eyes is dominant is easily established by extending both arms forward at the shoulder and forming a small triangular hole between the thumbs and index fingers. Pick a distant object and center it in the middle of the triangle with both eyes open. Without moving your head or hands, close 1 eye at a time. The eye that has the object lined up in the hole is your dominant eye (5, 12).

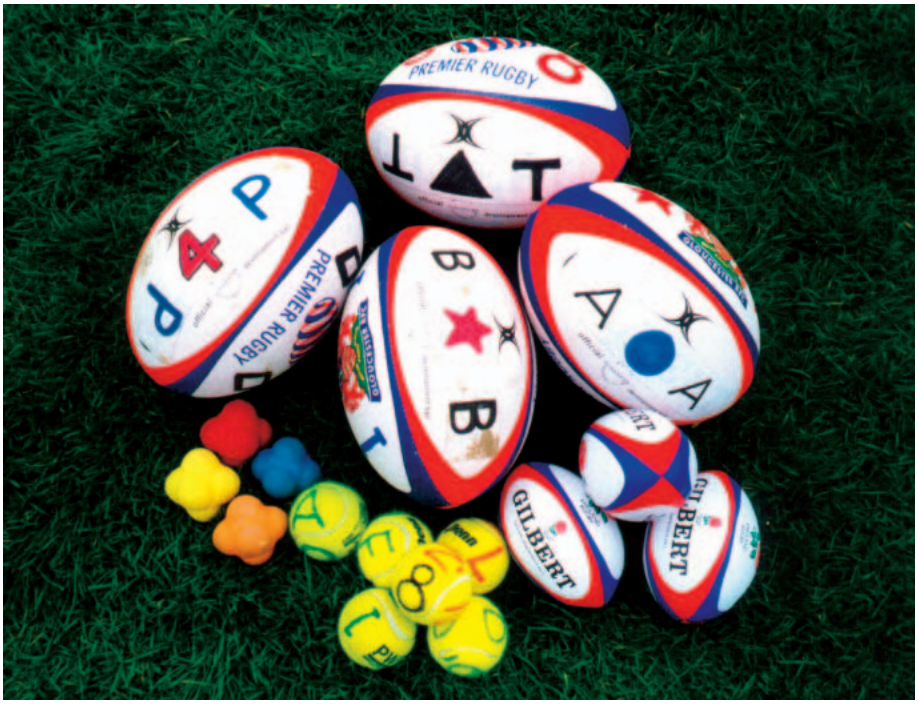


**Figure.** Marked rugby and tennis balls and colored agility balls used in visual-fitness drills.

Another important feature of the visual-fitness drills at Gloucester Rugby Football Club was the use of different-sized balls marked with differing numbers, letters, and symbols (Figure). Marked balls were used in a wide range of drills, from simple partner pass-and-catch drills that required the catcher to identify a nominated marking as quickly as possible before catching it to more complex drills that involved several players and also used eye patches. All these drills were used to encourage players to fixate on the ball as the passer released it. Fixation is limited to a surprisingly small area. Our ability to focus and see fine detail is restricted to an area (arc) representing approximately 3 to 5°. This area of focus is represented by the width of the thumb with the arm extended straight and the thumb pointing vertically (7). By using the central vision, which is ideally suited for recognition judgments and fine detail, focusing visual attention on important cues can help produce good decisions (i.e., effective anticipation) in training and competition (7, 12). Because this ability to focus is so limited, peripheral vision becomes increasingly important in sports. Our peripheral vision is designed to quickly detect motion so that the visual focus can be directed to other events (7). Wilson and Falkel (12) report that the size of an athlete's functional visual field is not fixed but varies according to a range of factors (e.g., the concurrent demands of activities performed in central vision; level of stress, fatigue, arousal). As a simple rule, the more complex and demanding the centrally performed task, or the more stressed the athlete, the narrower will be the functional visual field size, resulting in errors that coaches often describe as tunnel vision.

In addition to the drills with marked balls, drills were introduced with agility balls that placed players under pressure to maintain a good athletic position so they could respond quickly to the unpredictable bounce of the ball. These were often used to play games such as "agility ball tennis" indoors with small groups of players (e.g., 4–5 per side) as part of the recovery activities scheduled on the day after games (see the Appendix for the description of agility ball tennis). Different-colored agility balls were used to either increase or decrease the color contrast with the background and thus place more pressure on the visual system. Players found the use of agility balls a great deal of fun but also physically challenging and highly relevant to the reaction skills needed in training and competition. These balls were also used in the prematch warm-up and as an individual agility-and-reaction drill between resistance-training exercises that stressed the lower body. For example, a player would complete a heavy set of squats and immediately step away from the rack and complete 30 to 60 seconds of bouncing an agility ball against a wall. Players were required to maintain a good athletic position (i.e., on balls of feet, feet slightly more than shoulder width apart, knees flexed, and head slightly forward of hips) while experiencing the fatigue of the previous set. Similarly, between-set drills were used that might require a player to balance on a wobble board while catching a marked ball and nominate the designated number, letter, or symbol before catching it.

Visual training is considered to be totally safe (12), yet little information in the literature addresses guidelines for programming visual training into a sport-specific training program. In the case of Gloucester Rugby Football Club, the following approaches were taken:

- Visual-training drills were used as a regular part of the warm-up and the basic-skill development section of team training sessions on the field.
- Notwithstanding the aforementioned approach, visual-training drills were typically used in 2-week blocks for approximately 30 minutes within each session, and team skill training was conducted 3 to 4 times per week.
- Visual-fitness drills were often used in recovery sessions on the day after matches.

- Drills were designed for both indoor and outdoor use because of the highly variable weather in England.
- Drill progression was achieved by working on relatively simple catch-and-pass drills both with and without eye patches (both eyes were patched for approximately the same period of time) and progressing to more complex drills requiring players to make decisions, move into open space, and negotiate other players moving within the same grid area while catching and passing a ball and wearing an eye patch on 1 eye. All drills with eye patches were first performed without the patch, then with a patch on 1 eye and then the other, and finally again without the patch.
- Some drills were also made more challenging by using different-sized balls marked with various-colored symbols, letters, and numbers that players had to identify before catching.

All of this was applied while acknowledging the principal of specificity. Therefore, drills almost exclusively involved players working with a ball of some sort, and in activities that were considered relevant to various aspects of play on the field (e.g., catching, passing, kicking, decision making), communication and movement patterns related specifically to those seen in play.

## Conclusion

Even though visual fitness is an important quality for most athletes, rarely is any deliberate attempt made to integrate some form of relevant activity into a strength and conditioning program. A basic understanding of how the visual system functions and what its limitations are may help strength and conditioning coaches develop a range of drills that work to improve the physical qualities of not only the athletes but also the visual system. However, the effectiveness of visual-fitness training regarding improved performance is still unknown. Therefore, it is important to stress that in light of the current study, the objective of these visual-fitness drills was not to improve vision but rather to improve the speed, coordination, and endurance of the visual system of players at Gloucester Rugby Football Club. These activities have a lot of intuitive appeal for a wide range of sports, particularly the ball sports. One of the biggest challenges for strength and conditioning coaches is the almost constant pressure to reinvigorate training sessions with new, modified, innovative, and challenging training activities that address the sport-specific needs of their sports and the ongoing improvement and development of their athletes. Central to satisfying these needs is the provision, when appropriate, of activities that are fun and enjoyable for athlete and coach alike. To this end, the enjoyment experienced by athletes using these types of drills should not be underestimated and may be of particular importance to younger athletes. The visual-fitness drills described in this article introduce a new dimension into training that the players found challenging and fun. What more justification is needed to consider how visual-fitness activities can enhance the training environment and extend the strength and conditioning coach's repertoire? ♦

## References


1. Abernathy, B., J. Wann, and S. Parks. Training perceptual-motor skills for sport. In: *Training in Sport: Applying Sport Science*. B. Elliott, ed. New York: Wiley & Sons, 1998. pp. 1–68.
2. Abernathy, B., and J.M. Wood. Do generalized visual training programmes for sport really work? An experimental investigation. *J. Sports Sci*. 19:203–222. 2001.
3. Abernathy, B., J.M. Wood, and S. Parks. Can the anticipatory skills of experts be learned by novices? *Res. Q. Exerc. Sport*. 70(3):313–318. 1999.
4. Barnes, P.D., and K.W. Davids. The effect of physiological stress upon the functional visual field during sports performance. *Relay: Occasional Papers in Human Movement* (Vol. 2). 1984. pp. 30–32.
5. Calder, S. A specific visual skills training programme improves filed hockey performance. *Int. J. Sports Vis*. 5(1):3–10. 1998.
6. Fendick, M., and G. Westheimer. Effects of practice and separation of test targets on foveal and peripheral stereoacuity. *Vision Res*. 23:145–150. 1983.
7. Knudson, D., and D. Kluka. Impact of vision and vision training on sport performance. *J. Phys. Educ. Recreation Dance*. 68(4):17–24. 1997.
8. Long, G.M., and D.A. Rourke. Training effects on the resolution of moving targets: Dynamic visual acuity. *Hum. Factors*. 31:443–451. 1989.
9. McMorris, T. *Acquisition and Performance of Sports Skills*. Chichester, West Sussex: Wiley & Sons, 2004.
10. Revien, L., and M. Gabor. *Sports Vision: Dr. Revien's Eye Exercises for Athletes*. New York: Workman Publishing, 1981.
11. Rouse, M. Management of binocular anomalies: Efficacy of vision therapy in the treatment of accommodative deficiencies. *Am. J. Optom. Physiol. Optics*. 64:415–420. 1987.
12. Wilson, T.A., and J. Falkel. *Sports Vision: Training for Better Performance*. Champaign, IL: Human Kinetics, 2004.



**Acknowledgment:** I would like to acknowledge the valuable input of Dr. Mark Noble, ophthalmic surgeon MB, BS, DO, FRCS, FRANZCO, FRCOphth into the preparation of this article.


**Meir**


**Rudi Meir** is a senior lecturer within the School of Exercise Science and Sport Management at Southern Cross University in Lismore, Australia.

## Appendix
### Agility Ball Tennis

Organize players into 2 teams. The objective of the game is to score points against the opposing team. Points are conceded when a player on the opposing team cannot catch the agility ball after 1 bounce in his or her side of the court. The game is played by throwing the agility ball over the net so that the first bounce is within the oppositions side of the court past the halfway mark (as it is in tennis). The more players within a given space, the easier it is to catch the ball before the second bounce; therefore, it is preferable to have fewer players in a given space so as to increase the pressure on them to cover the area they are defending. Team size is dictated by the size of the area available (e.g., within the area of half of a basketball court, use 3–4 players per team). Define a suitable playing area with tape or cones to mark a halfway line that acts as the net. To increase the visual challenge on players, use an agility ball with low contrast against the court color (e.g., a yellow ball against the light timber color of the floor). Conversely, to make it easier to see the ball, use a high-contrast color (e.g., a blue ball against the light-colored floor). Introduce a second agility ball to increase the speed of the game and the demand on players to constantly react and respond. Encourage players at all times to maintain a good "athletic" body position, which allows them to react quickly and move into space to catch the unpredictable bounce of the agility ball. The first team to reach a determined amount of points wins. A variation is to eliminate players from the game who fail to catch the ball.