National College of Art & Design

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The Visual Language of Athletic Footwear

by

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1.0 Introduction

Sport became organised on an international level, in the middle of the last century. Only then could the functional requirements of athletic footwear for each sport be examined and defined. Mass production techniques and appropriate materials were developed and applied to their manufacture by companies such as Reebok and Spalding, who are still in business. Trained athletes were the sole market for athletic footwear. But social changes of the late 1960s attracted a large group of people to get fit. Their motivation was not to win races, but to become aerobically fit, mainly through jogging and other aerobic activities. Large numbers of unfit, uncoordinated, and athletically inexperienced people took to the roads. Bones, ligaments, and joints, were damaged by repeated and unprotected impact of load-bearing feet on hard ground. Appropriately designed footwear became increasingly important as a means of reducing fitness related injuries. It was at this time that many new athletic footwear companies began, including Nike and later Avia, who along with the older companies like Reebok and Adidas, increased sales at incredible rates.

Normal promotional channels such as advertising, endorsements from celebrities and sports stars have been used extensively. But companies have been very conscious that the product itself was the most important channel of communication regarding the performance and protection provided. That is, the product has to present itself to its potential customers. To do this athletic

footwear must communicate to the potential customer of the advantages it has over any other shoe in the shop.

The cushioning, traction and construction of athletic footwear are features whose visual expression merits detailed examination. It will be seen that a variety of expressions are used to communicate these performance features. A successful design will have a form of visual expression that will speak to the identified market. The markets including aerobics, running, off-road and tennis will be examined.

This notion of a product as a communicating entity raises the issue of what kind of language it uses and how this language can be decoded. According to Vestergaard , communication involves at least two parties, the addresser and the addressee (Vestergaard, 1985, p. 162). In the process of communication, meaning is transmitted between the two participants. However, meaning cannot be transmitted in the abstract; it must be embodied in some code, or language through some kind of channel. Any act of communication takes place in a context which involves the situation that the addresser and the addressee have been placed. Context includes the immediately preceding events, the encounter, but it also includes the wider cultural context of the addresser and the addressee, and the knowledge which they share about their total situation and culture.

Vestergaard further describes the variety of functions language can perform, as expressive, directive, informational, metalingual, interactional, contextual and poetic. The concern of this thesis is only with the expressive and informational function of the language. A language uses signs which signify real or conceptual objects. There are three categories of object namely icon, index and symbol. An Icon has a direct physical resemblance to the object it signifies. For example in visual languages photographs, representational drawings and statues are icons. An Index has a close association with the object it signifies. In visual languages the use of arrows imply speed, direction, or force. Visual symbols include colour coding of traffic lights or electrical wiring, as well as company logos.

Semiologists such as Barthes and Giard have asserted that there are visual "languages" used by designers. From this college, Dunne developed this concept of "design as language".

> Even objects will become speech, if they mean something. This generic way of conceiving language is in fact justified by the very history of writing: long before the invention of our alphabet, objects like the Inca Quipu, or drawings, as in pictographs, have been accepted as speech.(Barthes, 1973, p. 119)

In this case even athletic footwear can become speech, if they have something to communicate. Just as semantics is the study of meaning in language, product semantics is a phrase used to describe the use of products as a medium of expression. Like that of other products, athletic footwear semantics uses in its language, a vocabulary of two dimensional line, shape, colour, pattern and texture and three dimensional form and structure. In the

case of athletic footwear, bulkiness can be icon for protection. Autumnal colours are an index for off-road (trail) shoes. Use of Carbon fibre material is a symbol of leadership technology (especially in the aerospace industry).

2.0 The History of Athletic Footwear

A number of things led to the production of specialized athletic footwear. The industrial revolution saw the development of mass production, mass media and mass transportation. Shoes were being made in ranges of sizes. Fans could follow sporting events from different villages, towns and countries. More participants and spectators could travel further, faster and cheaper.

All these changes created a need for standardisation of rules for games and competitions. This need was met by the foundation of various sporting associations. This in turn allowed footwear manufacturers to specialize by meeting the regulations set out by each of the sporting associations. These included the Amateur Athletic Association and the English Football Association on a national level and the Olympic Committee on an international level.

2.1 The Industrialization of Footwear Production

As early as the sixteenth century, London shoemakers had been employing as many as sixty journeymen to turn out shoes in large numbers. Ready to wear shoes first appeared in Norwich around 1792, when John Smith abandoned the practise of measuring every foot and began to make boots of different sizes which could be tried on and bought on the spot. Two years later, Quincy

and Harvey Reed opened America's first retail boot store in Boston.

Rubber-soled footwear was developed in the US in the middle of the nineteenth century. A patent was granted to Wait Webster of New York in 1832 for his process of attaching rubber soles to shoes and boots.

> By the 1850s, the American shoe trade was leaving Europe trailing. Part of the reason for this was the speed with which they assimilated new mechanical advances.
> (McDowell, 1989, p. 38)

Also, scarcity of labour in America encouraged mass production, with the result that despite higher labour wage rates, American manufacturers could produce a wider range of styles at more competitive prices than European manufacturers.

In 1858 Lyman R. Blake of Abingdon, Massachusetts, invented a machine for sewing the soles of shoes, replacing the hand-sewing that had been in use since Roman times. Gordon McKay then improved upon the Blake patents. By 1864, the improved Blake sewer was commercially available in the US and England. Using this machine, component machinists could sew up to three dozen pairs of shoes per hour, a production rate unimaginable ten years earlier. The Singer Company then marketed another invention the lock-stitch sewing machine. These Singer sewing machines were in mass production by 1863, so that by 1901, more than one million pairs of American shoes were being exported annually to Britain.

2.2 The Organisation of Sports

Until the Victorian age, sport was largely an affair of games played according to ad-hoc rules between adjoining villages and towns. With the advent of cheap, fast, mass transportation, participants and spectators travelled further afield. In 1861 an American Indian by the name of Deerfoot came to Cambridge. "A crowd of 6000 including the Prince of Wales, watched the visitor win a six mile race"(Lovesey, 1979, p. 16). The formation of national and international controlling associations for sports such as tennis, bowling, hockey, badminton, football and volleyball, enabled compatibility between teams and competitors, regardless of their place of origin. With increased travel, a more homogenous market developed within each sport on an international level.

Well into the 1880s cricket, football and rugby were commonly played in ordinary, hobnailed heavy-duty leather workboots, which were unmodified except for the occasional addition of rows of metal studs to give greater grip. Not only were they cumbersome, but they were also very dangerous. As early as 1863 the English Football Association issued its first footwear ruling "#14 no player shall be allowed to wear projecting nails, iron plates or gutta percha on the soles or heels of his boots" (Cheskin, 1987, p. 7). Rulings such as this in many sports not only safeguarded players but also facilitated the mass production of specialist footwear to cater for the particular needs and requirements of each sport. In 1894 the Spalding Company's catalogue

featured three grades of spiked shoes. They were low cut, with kangaroo uppers, leather soles and six spikes. The top shoe in the range cost $6, a considerable sum at the time when the average American family of four lived on $11 per week. Sears Roebuck, the mail order company, listed specialised running shoes as early as 1897, the year after the first modern Olympics in 1896. Inspired by the Greek ideal of a healthy mind in a healthy body, "*mens sana in corporo sana*", public schools included athletics in their curriculum.

Some time between 1850 and 1900 the sport shoe look for the first time began to play an important role in the fashion of the day, thanks to the growing popularity of sports for women as well as for men. Boating, tennis and bicycling led the way with a rubber sole shoe with canvas or buckskin uppers. By the 1860s the first kind of sneaker shoe with a laced canvas upper and a rubber sole was in production as a croquet sandal. This was followed by the Spalding Company's rubber-soled canvas tennis shoe. Athletic footwear ceased to be exclusively a player's shoe and became a leisure shoe. It had become accepted in the America as casual wear for children by the turn of the century.

A parallel process was taking place in Great Britain. After unsuccessful experiments with cotton uppers and a variety of materials for soles, the New Liverpool Rubber Company developed a rubber-soled, canvas shoe of the same type as the earlier American one. Because the join between the two parts was sealed with a contrasting band of rubber, similar to the line painted

on ships to denote the safe loading level introduced in 1876 by Samuel Plimsoll, the new shoes were nicknamed plimsolls. Like their American counterpart, plimsolls were not confined to tennis courts and croquet lawns. They soon became standard beach wear and were commonly worn by children for outdoor play.

Figure 1 Athletic footwear in Sears Roebuck Catalogue, 1921.

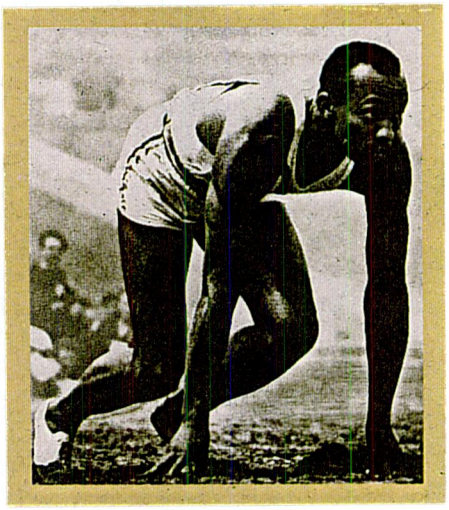

Figure 2 Jesse Owens

By 1921 a selection of specialised shoes for many sports was available through the Sears catalogue, (fig. 1) including baseball, tennis, golf, bowling and outdoor shoes for marathons and other athletic events. By 1936 Adidas shoes were internationally acknowledged as the best and were worn by athletes of the calibre of Jesse Owens (fig. 2)

In the 1940s, with most of the world at war, the American domestic market experienced its first major boom among the specialised sport shoe companies.

Basketball shoes produced by Converse were popular due to their comfort, durability and low price, as they are today.

3.0 The Fitness Revolution

Before the 1970s, The market for athletic footwear was limited to experienced athletes and children. Their needs were met by a number of companies, the largest at the time being Adidas. But the '70s and '80s saw a new phenomenon. Ordinary people began to physically push themselves without any other motivation but to become fit. Prior to this, athletes trained under guidance to win competitions and games for money, scholarships and glory. Non athletes of the time might have tried a bit of tennis or golf, but not to any intensity. However, fears of failing health, disillusionment in medicine, lack of stimulation in work and hopes of greater self control, saw people taking up sports and physical activities. Jogging and later aerobics became hugely popular. Most of these people were physically naive. Not having coaches like previous athletes, they encountered a host of jogging related injuries. Most of these problems could be solved with proper footwear. But lack of knowledge led to confusion amongst first time joggers.

Medical breakthroughs, in particular the antibiotic revolution in the 1940s and 1950s, seemed to suggest that humans could safely rely on the "wonder drugs" to protect their health. Just as enthusiasm for medicine had reached a crescendo in the mid-1960s, however, Americans learned about the dangerous side-effects of such powerful drugs as thalidomide and antibiotics. Confidence fell, according to national public opinion polls, from a high of 73% in 1966 to only 34% in 1980(Rader, 1991, p. 258).

Simultaneously a growing body of evidence indicated a relationship between health and lifestyle. Learning this, growing numbers of people tried to reduce or eliminate the more unhealthy aspects of their lifestyle such as smoking, fat intake etc. (Rader, 1991, p. 259)

In the late 1960s, Kenneth Cooper, an Air Force doctor, insisted that only exceptionally strenuous activities, such as jogging, running, racquetball, cycling or swimming raised the pulse rate to sustained levels adequate for one to become what he called "aerobically fit." Being aerobically fit meant that the heart and lungs were conditioned to cope with increases in activity. This growing American interest in activities that demanded aerobic fitness led to the inclusion of the marathon, for the first time, in ABC's television coverage of the 1972 Olympic games in Munich. Before that most Americans had little interest in long distance running. Sprint events were where their abilities lay. But when Frank Shorter, an American, won the marathon for the first time in sixty-five years, "No other specific event did more to encourage the running mania"(Strasser, 1991, p. 76). In 1970 only 126 men entered the New York marathon, but by the mid-1980s this marathon accepted the maximum of 20,000 "official" entries from both men and women while rejecting thousands of others.

Shorter's victory also coincided with a turning away from a focus on society to absorbtion with "self". Growing recognition of the limits of expertise and disillusionment with the government's ability to deal with race, poverty,

pollution, energy shortages and foreign affairs all encouraged the coming of the "Me Decade," the label social commentator Tom Wolfe gave to the 1970s.

> Many Americans sought greater control over their lives and greater personal satisfaction in areas other than jobs, consumption or social movements.... became converts to charismatic religions, experimented with vegetarianism, hallucinatory drugs, psychotherapy or became apostles of the new fitness cult. (Rader, 1991, p. 264).

The runners claimed much more than aerobic benefits for their activity. Running and other vigorous exercises that induced burning pain, pounding hearts and gasping lungs also helped satisfy human yearnings for concentrated awareness, a focused consciousness that drove away all distractions. Yet apart from building additional energy and reducing anxieties, running, according to its proponents, released endorphins, producing a mystical-like "runner's high," a trance-like euphoria that could be addictive. So important was running to individual well-being, according to a Runners Magazine poll in 1983, that 23.3% of the men and 38.1% of the women readers said that they would give up sex before they would abandon running.

> The fit claimed that they worked out so that they could have an edge in both personal relationships and in the workplace over more sluggish colleagues. They worked harder or were more mentally alert, they said, than non-exercisers.
> (Rader, 1991, p. 258)

Companies frequently agreed. They not only hoped to have harder working, more efficient employees but to reduce their insurance premiums and absenteeism as well. In the late 1970s many corporations provided their employees with stress management and dietary counselling and set up fully equipped gymnasiums with indoor tracks, saunas and exercise cycles.

Jogging was an inexpensive solution; it didn't require special equipment or facilities. However, it was not without pitfalls. Jogging-related injuries became widespread. The repeated impact of the foot landing on the ground sent jarring shocks up along the leg. Most affected were ankles, shins and knees. The mileage people were doing was more than the human body was designed for.

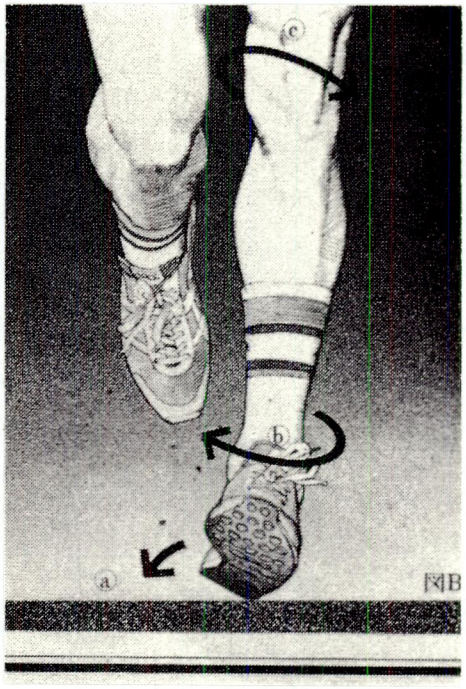

Figure 3 Angle of foot before impact

The solution lay in the choice of footwear. The two main problems that had to be addressed was shock absorption and over pronation (foot stability). EVA, a synthetic foam rubber, was applied in greater quantities under the heel. This prevented shock absorption but worsened stability (try running in platforms). By flaring the midsole, increasing the area of the outsole, stability was increased. This, too, was not without problems. When the heel landed the rest of the foot tended to slap down after it (fig. 3). This put undue strain on the ankles. Lots of solutions met the problems as they arose but not without their own drawbacks. Confusion reigned amongst consumers. The public wanted to know how to make the best decision.

In 1975 the magazine *Runner's World* began publishing controversial annual ratings. The popularity of the magazine showed how critical and fluent the market was, with the public's need to know what it was being offered on the shelves. Running shoes were literally stripped to pieces by experts in the fields of biomechanics, orthotics, podiatry and shoe construction, in order to discern which shoe was best for various applications. The threat of sports-related injuries forced the public to become familiar with materials, construction and design of their footwear. The results of tests on footwear held a huge influence on public opinion. There was a flood of demand for particular models that came out well in the survey. So retailers had to structure their orders according to the results of this *Runner's World* October survey. People had more money to spend and they demanded more and more sophisticated footwear solutions. It was not enough to demand the best; they needed to know it was the best to restore their confidence.

4.0 The Expression of Performance

Footwear in a high performance environment such as athletics must justify its existence. The very basic of requirements are that it shall protect, so the user can dedicate his or her full potential without fear of the injuries outlined earlier. This protection is most often in the form of cushioning and support. Secondly, the footwear shall provide greater traction with the ground or track surface. This traction can be provided by spikes or cleats, but is usually in the form of specially designed outsole treads in a selected material or combination of materials. Thirdly, the shoe should be an extension of the foot, so must provide a satisfactory fit between the foot and the shoe. This fit is dependent upon the structure, shape and construction of the footwear; but as this benefit must not compromise speed, the shoe must be lightweight.

A shoe can still fail in marketing terms. The final ingredient is the shoe's communication with users and potential consumers. If a person is not told, did not understand or remember the benefits of a particular shoe, then they can not make an informed decision. This communication of performance should be provided through the shoe. Communication through other media should be there to reinforce the message of each shoe. But if product awareness relies upon other media and not upon the design, there will be no way for a consumer to equate a shoe with what they have learned from other media. Confusion is much more likely to prevail.

A successful design must not only have cushioning and traction features that are attached to the foot with a lightweight, even fitting construction. It must communicate the presence of these features.

4.1 Cushioning

This section will cover the visual expression of cushioning as a performance feature in athletic footwear. Many studies have been conducted into the optimum quantity of cushioning. Too little could lead to insufficient shock absorption, and too much causes instability.

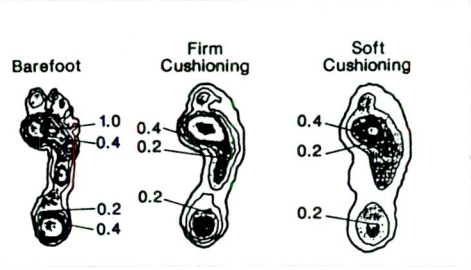

Figure 4 Pressure contour maps showing the effects of cushioning while running

> An athletic shoe cushioning or shock-absorbing system has the role of protecting the body from such potentially injurious repeated impact, generally by modifying the properties of the material used in the midsole. The effect of such a system is to delay the onset of the peak impact force, increase impact duration, attenuate higher frequencies of the shock and redistribute pressure beneath the foot as shown in fig. 4 (Barnes, 1993, p. 349).

Synthetic Foam

The cushioning properties of padding has been well established. Rubber soled footwear have been manufactured for the last 150 years. The 1920s and '30s saw increasing usage of sponge rubber heel cushions. However, it was not

until the late 1940s that the first modern polymer open and closed cell foam cushions were introduced as a shock-absorbing feature. The Boston by B.R.S. (predecessor of Nike) in 1968, was the first shoe with a full length cushioned midsole (fig. 5) and this has now become the norm for athletic footwear today.

Moulded EVA (Phylon) and polyurethane (PU) have become the two standard materials for midsoles. Each have their own advantages and disadvantages. A well thought out combination takes advantage of the strengths of both materials and enhances the overall performance characteristics of the shoe. The use of composite midsoles has been communicated to the prospective buyer through the use of contrasting colour (fig. 6).

Figure 5 The Boston marathon shoe, 1968

Figure 6 Dual density midsole

Originally these midsoles were cut and buffed. Now most are moulded, allowing huge potential as a platform for communication. A potential not fully exploited. The current style is a soft flowing sculptural form which rises and falls around the foot. This expresses the general idea of soft cushioning. Examples containing more conclusive expressions of cushioning include series of horizontal scores, that have the dual purpose of hiding wrinkles as they develop while also conveying the impression of compressive forces.

Some shoes were promoted as being lighter due to their perforated midsoles. This reduced the weight of the shoe without significantly reducing the energy absorption. But no one could physically see this through the outsole, so it never really caught on.

Nike Air

People have been familiar with the concept of pneumatics since Dunlop's first air filled tyres. This familiarity allows people to understand the same concept in other applications, including footwear. It was developed by an engineer by the name of Rudy, and was released in 1979 in a shoe called Nike's Tailwind (fig. 7). It was a shoe with a small air bladder in the heel of the midsole which was designed to prevent shock by absorbing the impact of the foot landing on the ground. Compressed gas was encapsulated in a tough urethane membrane. However there was nothing visually that differentiated this from any other shoe; only the wearer could feel the subtle difference.

Figure 7 The Nike Tailwind, 1979

Figure 8 The Nike Air Max, visible air bladder, 1987

Finally this hidden technological improvement in the shoes cushioning changed during a period of self assessment within the company, when sales had gone

down. In an effort to "let people know it's real" as expressed by Peter Moore,(Strasser, 1991, p. 203) "visible air" was developed (fig. 8). As a result, the Air Max from 1987 communicated visually to buyers the presence of air technology. This move "successfully re-established Nike as the technological leader in the industry"(Strasser, 1991, p. 204).

Many within Nike thought it was merely a gimmick and would destabilize the shoe. The question was asked, "how safe would you feel riding on see-through tyres?" (Strasser, 1991, 203) maybe, but it was through this visual evidence that people were happy to part with $65 for a pair, $15 more than the price of any of the competition.

Figure 9 The Nike Air Max2, with forefoot cushioning, 1995

Further development with air technology replaced even more foam from the midsole with air. The success of this concept of exposing the air bladder more and more, (fig. 9) lays in the effective visual communication of its function and value, not just to the consumer, but also to everyone else who sees the user wearing it. This stimulates greater sales, especially when sports stars are identified with this visible performance feature.

Avia Cantilever

The closest common application of Avia's cantilever concept is probably the bow spring suspension on cars, carriages and trailers. It was this solution to the problem of impact-related injuries that led to the birth of Avia in the Eighties. Standard solutions in other shoes employ a flat slab of foam in the midsole to absorb the energy of impact of a foot on ground. Avia's "signature product technology," the Cantilever, provides cushioning and stability, through the form of the outsole (fig. 11). It features a patented concave sole that flares out upon impact between the foot and the ground. The flared sole creates a wider platform and the outer sole lugs act as independent shock absorbers. As the heel lifts, the flared sole rebounds to its original, concave shape. The flared sole disperses shock outward, to reduce shock up the foot, leg and knee. The outer lugs absorb shock to cushion the athlete's heel strike and help centre the foot over the shoe, increasing stability. There is a real feeling that the foot is being suspended.

Figure 10 The Avia Cantilever

Figure 11 The Avia Advanced Cushioning System

In comparison with other solutions like Nike Air, Avia's Cantilever is incredibly simple, effective and inexpensive. The feature can be seen when held and felt when worn. But it is quite subtle to be seen by most consumers.Avia have released a further advance that they have been developing: the ACS or advanced cantilever system (fig. 11). In their words,

> the shape and placement of the columns in each of the advanced cantilever pods were engineered to provide the necessary support and to control the trademark flaring action of our cantilever sole. (Avia, 1994, p. 4)

The words echo the technical, even architectural feel to this development. The form of the "pod" evokes images of lightweight structural engineering usually employed in aerospace design or space frame bridge construction. The voids between the columns draw attention to this cushioning feature and communicate the idea of a support zone. When viewed from underneath, the use of a different coloured material between the two pods visually accentuate the concave form of the sole. This feature is most effective at communicating light cushioning and support, when manufactured of transparent rubber. But cost control has limited this. This is a pity because dark colours tend to absorb the effect of the voids and white tends to make them look cheap. Perhaps matte steel greys rather than "playful" colours like purple would show it to better advantage. Visually the cushioning system communicates much more than the normal block of foam as a sole.

The Avia Arc

This midsole support is moulded into the heel, designed to enhance the cantilever for lively response and durable cushioning. A transparent rubber

is used to reveal the entire component between the midsole and the outsole (fig. 12). This is particularly suited to the arc due to its peculiar shape. Comparisons could be drawn between this approach of using transparent materials and that of skeleton pocket watches, and more recently, that of Swatch watches. It greatly enhances their appeal to people intrigued by the internal components.

Figure 12 The Avia Arc component (blue).

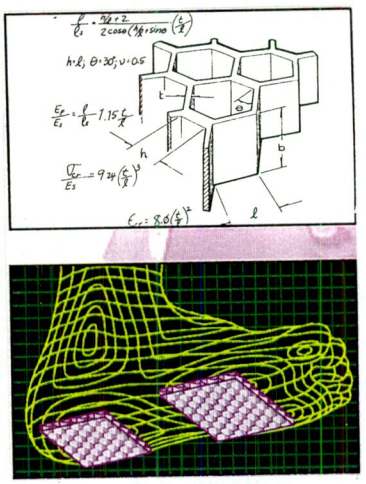

Figure 13 Reebok Hexalite

Reebok Hexalite

This lightweight honeycomb-shaped cushioning material is located in peak impact areas of the shoe: in the heel and the forefoot for superior shock absorption (fig. 13). Adapted from the aerospace industry, hexalite absorbs 20 % more impact energy than conventional EVA foam midsoles and is 4 times as durable.

The drawback is its visual impact. A hole is used to expose hexalite in a lot of the shoes. Unlike Nike Air with two side holes, Reebok put theirs through

the sole under the heel. This is ideal for the buyer to see before purchasing but is obscured when worn and used.

A second problem with Hexalite is its poor optical properties. Hexalite looks quite dull unless light is shining through it. If a more visually attractive material was used in its manufacture, then the form and the importance of the feature could be communicated with greater success.

A major selling point of all sports footwear is their performance technologies. They must be successfully communicated to prospective buyers through visual means. Nike and Avia both use the side of the sole to do this. However, it would be difficult for Reebok to do this with Hexalite. It is produced in sheets that are cut down to size leaving rough edges where bubbles were cut. It would not have the same simple form as Nike air.

Some Reebok shoes, like the Telos, use a hexagonal pattern embossed on the leather uppers to reflect the form of the hexalite in the sole. The hexagonal form evokes images of high tech laminates used in the aerospace industry. The close parallel with honeycombs also fits well with Reebok's ecological agenda.

Avia Fom

Avia Fom was developed from research conducted into the human foot's own cushioning. There is a dense fatty substance under the heel which deforms

and elongates when compressed. Avia Fom is a natural cushioning system located in key impact areas inside the midsole which mimics the way the foot compresses and disperses the shock from impact (fig. 14). Avia's research team explored synthetic materials until they found a foam which closely emulated this fatty tissue in the foot.

Figure 14 Avia Fom

Like all other cushioning technologies, the next challenge was to let people know of its existence, to differentiate it from other shoes and to prove its worth. Unfortunately, this material tears easily so it can't be exposed. Colour can be used to highlight and draw attention to features in athletic footwear. Avia use a canary yellow to communicate the presence of Fom. This yellow is applied to the insoles, portions on the outsoles and is used in graphics printed on the uppers. The consumer however must first understand the significance of this colour and second have faith in Avia for this signifier to succeed. Transparent rubber windows has recently been used to reveal the Fom through the sole. It was far simpler to use a yellow coloured outsole and insole. Looking through one rubber at another is not as impressive as exposing a bubble of air or a carbon fibre component.

Adidas P.O.D.S.

The Point Of Deflection System introduced by Adidas, like Avia's Cantilever,

brings the shoe's cushioning system to the outsole where it is visible. Hollow non-pressurised chambers within the lugs absorbs the impact from each landing. This function driven feature uses very linear forms to communicate its technical efficiency (fig. 15). However, this concept still relies upon a dual density EVA foam midsole, so it doesn't actually save any weight.

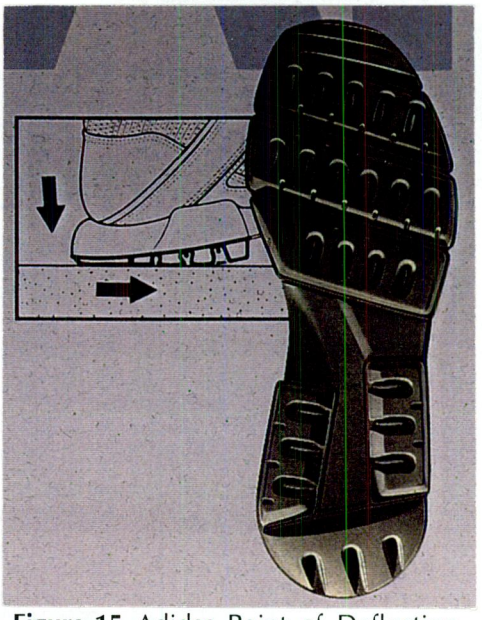

Figure 15 Adidas Point of Deflection System

Solutions to impact-related injuries are varied and plentiful. As well as the ones mentioned, there are gel and water-based solutions. There are even patents for soles full of metal springs like in a bed. In the end successful designs will be judged upon their energy absorption, stability, comfort and the all important manner in which the feature is communicated, differentiating itself from competitors.

Solutions within the midsole, like Reebok's Hexalite and Avia's Fom, need a lot of help to sell themselves. Even though they are sometimes exposed, they don't create a visual impact. Unexposed solutions rely entirely on external media to communicate the feature and associative forms to act as a reminder.

Solutions using the outsole, such as Avia's Cantilever and Adidas' PODS succeed in communicating their cushioning features to the observer when held upside down. Avia's Arc differentiated itself by exposing a carbon fibre component that did create a visual interest. But all of these shoes do very little to promote themselves to others when being worn.

This is an important factor when a large television audiences are watching sporting events. In an article about Nike in *Graphics* Tinker Hatfield a designer, revealed

> It is important to design sneakers with television in mind, they must be visible from 100 feet away (so they come up on television), or to kids down the street, (Hamilton, 1990, p. 67).

This is where Nike's Air and Avia's ACS put others in the shade. They both use the side of the shoe to communicate their cushioning features for all to see. In both cases the actual cushioning action is happening elsewhere. The Nike Air is in the centre of the midsole and the Avia ACS absorbs the impact across the bottom of the sole. But both manage to bring it to the surface of the shoe for the casual observer to witness.

4.2 Traction

Traction is an important performance related feature of athletic footwear whose visual expression merits in-depth analysis in the following section. Overcoming slipping and improving the efficiency of acceleration and deceleration has been the aspiration of shoemakers long before any knowledge of the need for cushioning and support existed. Successful traction is dependent upon the coefficient of friction between two materials, mechanical interlocking, quantity of moisture and dust between surfaces and then the pressures parallel and perpendicular to the surface. The form of the lug pattern on an outsole is most important over soft or textured terrain. The visual expression of traction is usually through the colour and texture of the materials used and through the form of the lugs. The use of particular types or brands of materials have to be communicated through brand names moulded into the material.

Particular forms appear on soles according to their application. Some have evolved in response to the needs of sport, others have been borrowed from sources that have proven successful. Many have evolved because of the terrain for which they are designed (eg. Water sandals). Following a narrow escape from death in a boating accident caused by a slippery deck, Pail Sperry invented the "siped" non-slip sole. Sipes are thin grooves through which water is allowed to escape from between the sole and the ground. They were first developed by tyre manufacturers to prevent aqua-planing in wet

conditions.

It is common for outsoles to emphasise their connection with automobile tyres to reinforce their market identity. Road trainers are often soled like slick road tyres, while off-road runners have rugged soles that refer visually to 4x4 wheel drive tyres. This is not just a visual thing; the problems faced by driver and runner are not dissimilar. But it is also a powerful tool to communicate performance by association.

Materials have played an important part in improving traction, especially over hard, smooth surfaces. Quite often an outsole will be a combination of materials, according to requirements in particular areas.

Gum Rubber

Gum rubber is used in the heel and toe of some soles for its good grip and wear resistance. Its presence is easily indicated by its natural translucent brown colour (fig. 16). It is usual to use contrasting coloured rubber in the rest of the outsole to visually accentuate this high performance material.

Figure 16 Outsole with Gum Rubber components.

Vibram

The development of Vibram soles (fig. 17) was motivated by a climbing tragedy in the Alps in 1935. Vitale Bramani developed a multi-purpose sole

material to replace two different shoes previously required by mountaineers. It is suitable for the rugged approach climb and can still provide safe, sure-footed traction needed on rocky surfaces. Vibram soles are distinguished by their distinctive lug patterns and the yellow lozenge name tag on the centre of the outsole, which are standard on all quality hiking and mountaineering boots.

Figure 17 Vibram sole

Goodyear

Goodyear's Indy 500 is a rubber that has been developed specifically for footwear. It is known for its hard wearing qualities and good traction. Having the Goodyear name on the outsole is a strong selling point. The name conjures up images of sports cars hurtling at incredible speeds, clinging to the ground with smoking tyres. A mental association is made that if Goodyear rubber can endure this treatment, well it can surely survive the weight of a body on a tennis court, no matter how fast you turn or run. However it requires the tiny block of text to visually differentiate it from any other outsole material. Natural Gum rubber and its distinctive translucent brown succeeds over the others to visually communicate its use in a shoe's outsole.

4.3 Construction

The shoe's construction keeps the sole of the shoe attached to the foot. This structure must fit well around the foot and provide support and protection from ankle sprain and other injuries. But above all it must be lightweight. The visual expression of these features in a selection of athletic footwear will be analyzed in this section.

Cushioning and traction, the features discussed previously, can only work if the sole is attached properly to the foot. This is the primary purpose of the uppers of all high performance athletic footwear. Successful connection between foot and sole is dependent upon a number of factors. First, there has to be a snug fit between the foot and shoe. This is an obvious statement, but no amount of performance enhancing product technologies will be worth a damn if a poor fit (from loose shoes or from concentrated pressure points) is causing blisters, cramps or other discomforts. Fit is hugely important in any footwear when worn during intense activities for any period of time. Different activities require different fittings. Hiking boots need an ample toe box, while sprint shoes should be semi-pointed to prevent toe-spread during acceleration.

Secondly, the uppers have to provide support in certain areas for certain applications to prevent over pronation and heel drift. Thirdly all this must be achieved while keeping weight to a minimum, most especially for competition

footwear where winners are differentiated by fractions of seconds.

Figure 18 Nike running shoe

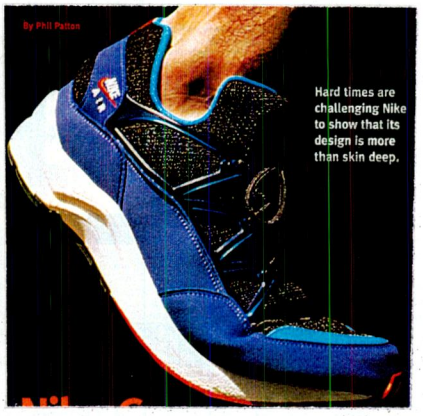

Figure 19 running shoe

Tight fit, strong support and low weight are communicated in a number of ways. Running shoes with their lightweight uppers communicate the use of high performance fabrics through the use of synthetic, fluorescent colours. Bands of material are used to show reinforcements being used at points of high stress (fig. 18). A new, developing solution is an exoskeletal shoe. This style of shoe uses material only where necessary eliminating any material where it is not required (fig. 19). Solutions look like anything from an extension of the foots anatomy to a piece of structural engineering from an aeronautical research department. Cushioning was a battle of one shock absorbing concept against another. Construction on the other hand is seeing different interpretations of the same goal. To achieve a comfortable fit with the least amount of material. Most are using a tight stretchy fit. Outside this is either an air filled bladder, a cable system or a cutaway leather upper that all tighten around the foot.

The importance of weight reduction can not be over stated. Athletic footwear manufacturers are only one of many industries where weight reduction is of paramount importance.

> A thousand dollars a kilogram of reduced weight-that is the price that, according to a French study performed in 1985(Euroconsult), the aerospace industry is willing to pay to lighten a satellite. This reverse bargaining, in which one pays to have less, takes place in other markets as well: 215 dollars for a kilogram less of helicopter, 140 for commercial airliners, 7 to 70 dollars for sports equipment, and from 2 dollars to 3.50 for trucks. (Manzini, 1986, p. 97)

Features of such value and importance, need to be expressed to the potential customer. Lightness has been an important characteristic of sportswear for the following reasons: it allows greater freedom, greater speed, and is less tiring. Thus manufacturers have reduced the weight of rugby boots (fig. 20) from 500 grams to 250 grams by the use of a low cut, streamlined design, and by the use of plastics which keep the weight low even in wet conditions, due to the non-absorbent qualities of the material.

Figure 20 New and old rugby shoes

Figure 21 Adidas Stripes

Adidas stripes

The Adidas use of stripes on the exterior of their shoes was probably the first visual expression of footwear construction. They were originally developed out of necessity to strengthen sides of soccer shoes, to allow the use of the

lighter leather that would otherwise split. This has been one of the first successful marriages of form and function in athletic footwear. Although they originally designed shoes to have many different stripe combinations, they finally settled on three, as a standard functional support system. When used in contrasting colours to the rest of the shoe, a distinctive look was created (fig. 21). Adidas trademarked this as their logo in 1949.

An interesting development of the logo occurred where the negative space between the three bands was used for ventilation in the form of three long openings on the shoes (fig. 22). There is no better way of reducing weight than removing material from where it can be dispensed with, resulting in a more open structure.

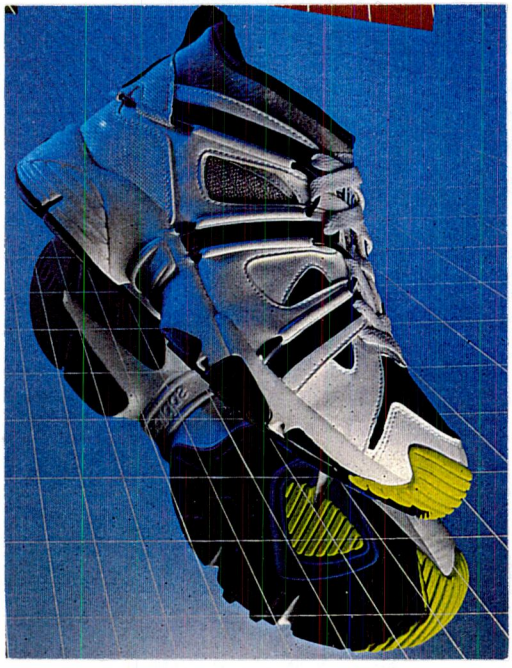

Figure 22 Adidas Cable Strapping

Figure 23 Reebok Insta-pump bladder

Insta-pump

Reebok Fury's main visual features are its fluorescent colour and the shape of the bladder (fig. 23). The valve and button can be seen; there is no doubt what they are. Reebok use a luminous yellow to highlight the Insta-pump external bladder on their Fury running shoe. An adjustable tight fit can be maintained by inflating the bladder, which presses in against the foot.

Carbon Composites

Carbon fibre laminates were originally developed by the aerospace industries. It showed great potential for use where applications demanded light weight and high rigidity, for example, aircraft wings and helicopter rotors (fig. 24). Graphite has also found applications in footwear. The high price of carbon composite components demands that their presence in a shoe is communicated.

Figure 24 Carbon in the aerospace industry

Communicating the use of graphite components could be compared with the philosophy behind the Centre George Pompidou, which is, turn it inside out.

Avia Tennis Shoe

An example is the carbon fibre heel counter in Avia's tennis shoe (fig. 25). Normally the heel counter is a sheet of formed thermoplastic that is between the inner lining and the upper material. Instead the laminated carbon fibre was used in Avia's shoe as an external heel counter, making a striking visual statement.

Figure 25 The Avia Tennis shoe

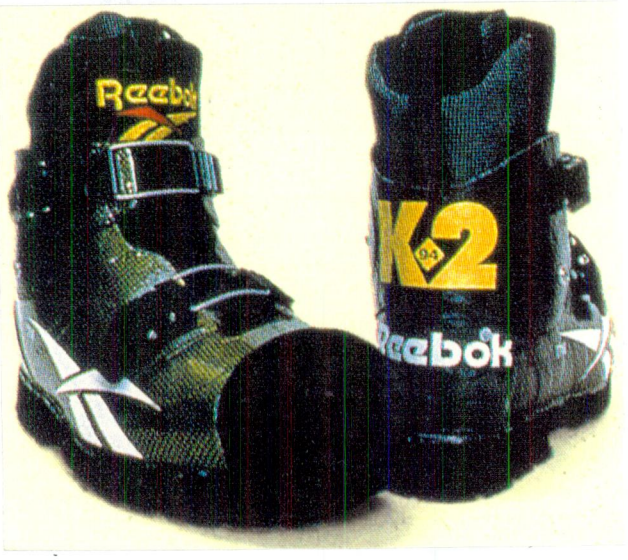

Figure 26 The Reebok K2 mountain boot

Reebok K2 mountain boot

Until Reebok got involved with Adrian Burgess, prior to his attempt to climb the K2, the most modern boots in production were constructed of injection-moulded plastic uppers with walls up to six millimetres thick, which were considerably lighter than their leather predecessors. Reebok did not have any previous experience in this area, but Nick O'Rourke working closely with Burgess, succeeded in reducing the weight by 35%.

The solution lay in the innovative use of Graphlite (fig. 26) to construct a

lightweight shell. According Burgess, "their lightness and support were severely tested in very technical situations. They performed beautifully" (Reebok, 1994, p. 2). This high performance driven design brings carbon fibre into the vocabulary of footwear design. Rather than cover the material, O'Rourke let the distinctive pattern and texture of graphlite to express its presence.

Figure 27 The Reebok Fury

Reebok Fury midsole

In an expression of engineering, Reebok have employed materials in their Fury running shoe (fig. 27) developed from aerospace industries, not only to reduce the measured weight of the athletic shoe, but also the visual weight. Prior to this, support was provided by plain bulk of foam throughout the midsole. However this material was being required to provide support, but also to absorb energy from impact, two noticeably different demands. These were met separately by Reebok. As if designing from the bare foot, a

composite of woven glass and carbon fibres are moulded to accommodate the sole. Shock absorbing foam was provided only where required, under the heel and forefoot. The use of a graphite composite from the aerospace industry has allowed Reebok to develop a range of shoes that weigh less without sacrificing cushioning and stability. In some cases, part of the outsole may be cut away, leading to shoe weight reductions of up to 10 %. If ever there was a triumph of visual footwear engineering, this radical removal of material is as big an achievement as the gothic arch.

Carbon fibre composites are the chrome of the nineties. Chrome originally being an effective means of protecting ferrous metals from corrosion. But was accepted by automobile designers in Detroit with open arms.
The role of carbon fibre laminates is critical in maintaining lightweight torsional rigidity. Its distinctive appearance makes it a joy to expose. Rarely if ever is it used in a shoe without even the smallest portion being visible.

After comparing different visual expressions of cushioning, traction and construction features, a few conclusions can be drawn. Four elements make up any product technology in athletic footwear. These are material, form, concept and medium. Nike Air uses the concept of an air filled cushion, in the form of a bubble that is expressed through the medium of a hole in the midsole. Reebok uses the form and concept of a bridge constructed from a carbon composite, that is communicated by the amount of foam midsole that can be removed. If any of the four elements do not exist, the feature cannot

exploit its full potential. The Nike Tailwind for example, had the concept of an air filled cushion, but with no medium to communicate its existence. Nike nearly dropped the entire concept after the poor response.

The sole, too, becomes the very symbol of the art of athletic footwear. It is a structure under repeated compression, while the upper is mostly a tensile structure, whose function it is to keep the sole against the foot without drifting. The form and materials chosen can reflect these internal and external forces endured by the entire structure. Reebok and Avia have challenged matter and its weight, with the Fury running shoe and the Advanced Cantilever System.

5.0 Grammar for Market Identity

Market identity for performance athletic footwear is the culmination of the expression of each of the shoe's product technologies. It has been demonstrated that there are many possibilities when it comes to expressing individual performance features. A successful design can use particular forms of visual expression to speak to the identified market. Usually the markets are broken down according to activity: running, aerobics, cross-training, off-road, etc. However, these divisions are not set in stone and constantly evolve and overlap in a healthy, dynamic market. Often it is unusual combinations that uncover new markets.

The performance sandal is a case in point (fig. 28). Ten years ago all sandals were either cheap plastic flip-flops or cork and leather Birkenstock-style footwear. But the last five years have seen an explosion, with Teva, Nike and Avia all having their own range of open footwear. The sandals are designed with performance in mind, using new and existing product technologies. All have achieved huge success. New and interesting variations can produce surprising results. However as with all languages rules of grammar apply.

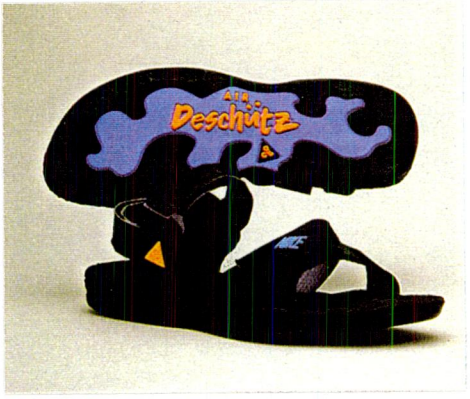

Figure 28 Sports Sandals

A performance product will not succeed on the strength of its communicated performance features: if it sends contradictory, misleading messages; if it can not be understood. Visual contradictions will cancel the effect of individual features being communicated; misleading information will destroy consumer loyalty and unintelligible visual noise is wasting the consumer's time.

When Adidas realised the strength of contrasting colours, and the simplicity of their trademark ensures instant recognition from long distances. With the advent of television coverage of sporting events, athletic footwear makers began to use strong colours to draw recognition. In addition to being used for publicity and immediate product recognition, colour is used to attract different markets. Even when the product is the same, colour can change its visual message. Colour can be used to adapt products for markets according to season, culture, gender, beliefs or age,

> specific cultures of colour formed for different ethnic groups and peoples, each with its own hierarchies, each attributing different symbolic values to each colour.
> (Manzini, 1986, p. 195).

Athletic shoes marketed for different nationalities also vary in colouring. South American and southern European countries use more mauve, orange and red colours than their northern counterparts.

It must be admitted that most purchasers of high performance sports footwear simply do not have the ability to exploit the product's potential. According to an interview with Paul Fireman, CEO of Reebok,

> This follows a principle codified in the company as the 80-20 rule: Eighty percent of all athletic shoes are never put to their intended use. What makes the business so complicated is that in spite of 80-20, customers still tend to evaluate athletic shoes on their supposed performance value.
> (Sedgwick, 1986, p. 30)

This can be explained by the desire of the customer to appear rational in his choice, and product performance messages provide him with such a rationale. With such a range of footwear it is important that each shoe communicates its purpose to the buyer. It should also communicate the wearer's activities and aspirations to the observer. A shoe's purpose can be expressed by using elements, forms and materials that are common in other equipment used in its particular application. Often the use of similar materials is by necessity, the opportunity should be exploited.

Outdoor

Avia's N'yati is a hybrid of several outdoor products (fig. 29). It borrows features from running shoes and from hiking boots. The shoe is intended to be used for running along trails through the forest, desert and fields. The shoe employs the light-weight materials of running shoes. Due to the uneven terrain, stability is an important factor, so an adjustable fitting system is used to ensure a tight fit around the foot.

The N'yati's most distinctive feature is the ankle gaiter with an adjustable toggle. Gaiters, usually separate, are a waterproof covering for the ankle worn by climbers and walkers to prevent snow, mud or gravel entering over

the top of the boot, a familiar sensation to most of the market for which the product is aimed. Joe Bevier's innovative integration of the gaiter into the boot, visually identifies this shoe as being an off-road shoe suitable for its particular market. It doesn't make the shoe the most beautiful shoe in the world. But, by borrowing the visual vocabulary of gaiters, rucksacks and other outdoor equipment, it has greater meaning and value to its market, who place higher priority on performance than on aesthetics. Continuing this off-road metaphor, another shoe has an outsole with a part of it moulded from the distinctive chunky tread of the tyre of a mountain bike. It is another clever quotation, easily interpreted by this market.

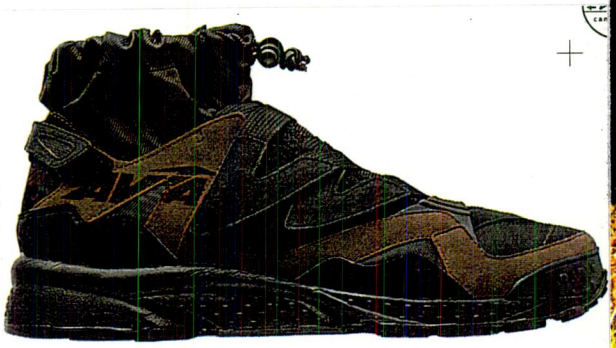

Figure 29 The Avia N'yati

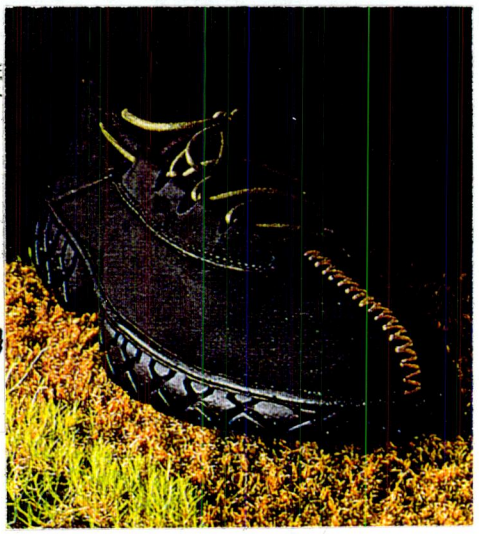

Figure 30 The Nike Ida, with reground soles

Many footwear companies have started using recycled materials in some of their products. The Reebok Telos uses materials and processes that minimise the environmental impact of production. Nike, uses reground tyres in outsoles for the Nike Ida (fig. 30). White flecks left from the recycling process, but no effort was made to remove them because their presence visually identifies the material as being recycled.

Running

Carl Lewis, the multiple Olympic gold medallist, endorsed the products of Mizuno, the athletic shoe company. Mizuno collected a team together to redesign their running shoe from the ground up. The result was an incredibly light pair of shoes. The sole was a single injection moulding of Pebax (a flexible plastic), with uppers made of the finest, lightest synthetic fabrics. The tolerances were so fine each pair was only designed to last one race. Fifty pairs were made in his shoe size only, at no small cost. Not only did he win the race he beat the world record of the time. The publicity generated world-wide was priceless. From the publicity perspective, comparisons could be drawn between this fine tuned tailoring, to the automobile equivalent, the Grand Prix. Mercedes explained that part of the reason for their entry into the Grand Prix was the contribution such a focus made to their long term research and development, but the primary reason was that of prestige and publicity (Rees, 1990, p. 9).

Sprinting is an activity with clear cut objectives to be fastest and win. This has allowed really refined technical design reflected by the synthetic colours

Aerobics

Aerobic shoes are a hybrid of trainers and dancing slippers (fig. 31). The Reebok Freestyle originally came in white and other soft pastel colours. This soft image was shattered with the colours used in their "Neon" range, expressing the shoe's purpose for lively dance and aerobics (fig. 32).

Lightweight garment leather that was used. The wrinkles that form naturally in it have been used to identify the shoe as being closer to a ballet shoe.

Figure 31 The Freestyle, as ballet shoes

Figure 32 Neon range of the Freestyle

The Freestyle, Reebok's first aerobics model, was a flattering fit, and made a woman's foot look narrow. "Simple Elegance" was the way Reebok's advertising defined it. The upper was made of "garment" leather, an ultra soft, comfortable, light material.

The story goes, according to Strasser, when the first samples came from the Korean factory, the owner sent a letter apologising for the wrinkles in the toe and said it was a mistake they were correcting. The Reebok men liked the wrinkles and thought they made the shoe look more like a ballet slipper, which was the look they were after. It took factory workers six months to learn how to put the wrinkles back in the shoes. Women liked Reeboks instantly because they didn't require a break-in time, they were much lighter

than chunky running shoes, and felt like slippers. Originally they came in white, to be followed by a full spectrum of tones and colours, from soft pastel pinks, to intense red, blue or yellow.

At the time, people in Nike could not understand why a light, soft sided shoe with few features could be so successful. What they did not understand was that two different were being spoken. Nike, one of technical athletics. While Reebok learned to speak lighter, more lively tones that befitted this new market.

Tennis

Tennis can be a conservative market. Colours are often limited to white and green. However tennis shoes make a feature of using high tech materials. The use of carbon composite in shoes appeal to the tennis market that had already been familiarised with carbon through its use in tennis rackets (fig. 33). In fact tennis shoes ride on the back of tennis racket advertising that has already been promoting the benefits of carbon composites.

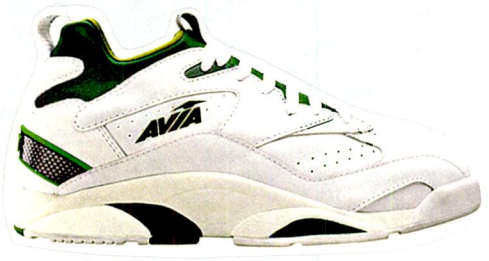

Figure 33 Avia Tennis shoe

6.0 Summary and Conclusion

Since the foundation of the various sporting associations, athletic footwear has been developed along a number of strands, according to the individual performance requirements. The consequence of developing in different directions has led to variations in form. At first subtle, these variations between say a running shoe and a rugby shoe became visual indicators as to the nature of the shoe. Athletic footwear was usually bought on the recommendation of coaches. The fitness revolution in the 1970s changed this. Millions of people took to the streets without advice or experience. When shin splints and other jogging related injuries were encountered, people had to rely on other joggers, sports writers and advertisements for explanations. The solution lay with proper footwear. The athletic footwear companies offering their own solutions grew in numbers during the 1970s and 1980s. To compete, they had to communicate their products' advantages to potential customers.

This thesis follows the quest to express the main performance features of athletic footwear. The problems encountered by all cushioning concepts, is how to express a shock absorbing action that takes place inside the sole of the shoe. Nike and Avia both succeed in drawing the viewers attention to their cushioning technologies. They use voids in the side of the midsole to communicate the presence of the Nike Air bladder and the Avia Advanced Cushioning System. By doing this, their features are exposed for everyone,

including potential customers, to see, improving general product awareness.

Traction is dependent on outsole materials and lug patterns. Consequentially, to explain its advantages, a materials unique characteristics must be exploited. Relevant applications of gum rubber succeed over other materials, not having to rely on small print to communicate its presence.

The lug patterns that are most convincing, visually refer to successful traction features from other applications. A potential customer seeing, at a glance, an outsole styled like the tyre of a mountain bike, can immediately perceive the benefits, for off-road applications, of the lug pattern being offered.

Successful athletic footwear construction must communicate the provision of lightweight support and good fit. Reebok uses an air bladder that tightens around the foot when inflated. This bladder is totally exposed in the Fury running shoe. Adidas' use of a cable structure allows the removal of the nonstructural portions of the leather uppers. The cut-away sections give the shoe an exoskeletal appearance. Nike have used tensile structures in their Air Hurache and Air Max2 running shoes. The fluorescent blue Pebax components stretch over the midfoot like tendons, expressing a taut lean structure that firmly fits the shoe around the runners foot. This visual expression of a tensile structure, communicates an desired solution to runners. They need even pressure around the foot to prevent the sole from moving underneath, for stability.

The expression of all the shoes' features should tie together to communicate a conclusive message of the shoes benefits to the shoe's targeted market.

Finally, the focus of this thesis has been the visual expression of performance features in athletic footwear. Choosing a particular range of products on which to focus allows the concept of product languages to be explored to a reasonable depth. It should be obvious that the visual expression of performance features is not just limited to athletic footwear. The use of form and materials as the basis of a language in other products would merit investigation. Even with the focus of athletic footwear, a great deal more could be achieved. Giard outlined four essential stages of communication. When a statement is made: it may go unnoticed, it may be noticed but not understood, it may be noticed and misunderstood, or if actually successful, it will be noticed and fully understood (Giard,1990, p. b-6). The greatest challenge to designers is ensuring their message is understood.

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