

Sensory Footwear and Apparel for Golf:

An In-Depth Analysis of the Effects of Proprioception on Putting Performance

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Project Overview

Golfers of the 21st century are data driven, craving technological feedback on every minute aspect of their game. Old-fashioned training aids are now being replaced by fancy swing analysers, providing knowledge for both elite players and casual golfers. On average, golfers are typically high earners with an average household income of \$100,950, willing to spend between \$500- \$1000 annually on new golfing equipment (Who is the Average Golfer?, 2020). Their exclusive budget combined with their desire for improving performance and acquiring knowledge has created a market saturated with technology designed to aid and analyse every aspect of their swing. Once a traditional sport used as a means of escape from fast paced reality, golf is becoming ever more consumed by technology. Nowadays it is not uncommon to find golfers engrossed on their phones during the game, obsessing over the information carried by their devices, preoccupied with trying to improve and better their stats throughout the round.

This research explores the idea of proprioception and how this sixth sense can be harnessed and integrated into golf footwear and apparel to provide tangible feedback that provides the knowledge desired to better performance, while also enhancing the putting experience by encouraging players to further immerse themselves in their environment.

Professional Interest

My mission as a designer is to make products that excite and motivate people to play sport. I believe products should inspire enthusiasm and encourage everyone to participate no matter their sporting ability. Through utilising my design and engineering knowledge, I aim to create thoughtful solutions that advance sporting performance while challenging the current aesthetic standards of traditional sport.

This project will result in an innovative series of products designed to motivate and inspire athletes of all backgrounds and abilities to play golf and improve their performance. The products will aesthetically push the boundaries of current traditional golfing footwear and apparel standards.

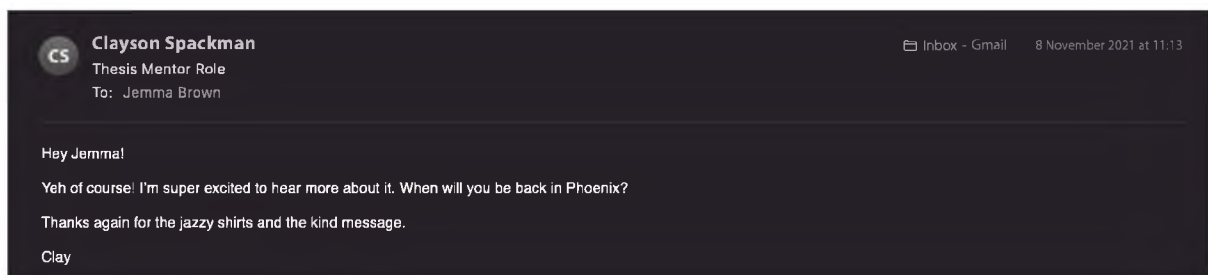
I believe this project will enable me to showcase my skills as both a designer, engineer, and athlete. By the end of the project, I will understand fully how to design footwear and performance knitted garments from conceptualization through to product fruition. It will also provide me with an opportunity to further immerse myself and connect with individuals in the golf design and engineering world, allowing me to gain an even deeper understanding of the golfing industry and where the market is headed.

I Personal Strengths

I believe that utilising my personal strengths will be key in ensuring the overall success of my thesis project. My top five strengths are harmony, analytical, discipline, individualization, and consistency. Harmony will enable me to create and maintain meaningful relationships with relevant contacts throughout the project. Individualization will build on these relationships, helping me to build a cohesive, productive team of people all working towards a common goal. Discipline will help me to efficiently accomplish tasks and continue with strong work ethic until the project is finished. Finally, my analytical traits will enable me to identify potential problems and help me to make decisions that will ensure the success of my project.

II Mentors

I will be meeting with Clayson Spackman, an innovation engineer at Ping whom I worked with over the summer. He has skills in product design, CAD, prototyping, testing and data analysis. He is also an experienced golfer. We will meet at least once a month either in person or over teams to discuss project progress and design direction. See mentor confirmation below.



The History of Golf

While the origin of golf is still unclear, it is thought that the modern game originated in St Andrews, Scotland. The town is widely renowned today as the 'home of golf' with records showing that locals played upon the St Andrews Links as far back as the early 15th century (*The History of Saint Andrews Links, n.d*). In 1457, the first written reference to the game was made when James II banned it, along with football, as an unwelcome distraction from archery. King Charles subsequently introduced the game to England, while Mary Queen of Scots introduced it to France (*Weathersby, 2017*). The popularity of the sport quickly spread throughout 16th century Europe due to its royal endorsement.

It was not until 1744 that golf was pronounced an official sport, when the Gentlemen's Golfers of Leith, Edinburgh, formed the first golf club and arranged a yearly tournament (*Johnson, n.d*). In 1754, the Royal and Ancient golf club (R&A GC) was founded

in St Andrews and by 1764 the first standard 18-hole golf course was established here (PGCC, n.a). The R&A GC remains to this day, the main governing body of the sport.



Figure 1. St Andrews, Old Course 1849 vs 2015. (Porter, 2015)

During the 19th century as the British Empire Expanded to encompass the globe, so golf followed closely behind. Records show the formation of the first permanent golf club in the United States was in 1888, Yonkers, New York (*At The Tee, 2018*). By 1893 the first ladies golf club, the Ladies Golf Union (LGU), was also established (*Scottish Golf History, n.d*), while one year later in 1894, the United States Golf Association (USGA) was founded (PGCC, n.a).

It was not until Paris,1900, that golf was introduced to the Olympics, however, it was later removed from the event in 1921 due to issues that arose with the rules and lack of popularity (*International Olympics Committee, 2015*). More recently, golf made a return to the Olympics, making its first appearance in almost 100 years in Rio, 2016.

Target Market

The US golf market is the largest in the world, closely followed by Japan and South Korea, with the US and Japan alone accounting for around 2/3's of the world golf equipment market (*World Golf Report, 2021*). In particular, the demographic of young adults (18-34 year olds) has become the largest segment of golf product consumers. Engagement with this population has remained steady over the past 7 years, making it a profitable, reliable target

market. A record breaking 5.9 million Americans within this age range played on a golf course in 2020 (*Go.f Industry Facts, 2021*).

Over the past couple of years there has been a surge in the number of people playing golf across the world as people have sought out the socially distanced outdoor activity during the Covid pandemic. Last year, the sport also saw its largest percentage increase in beginner and youth golfers since 1997, the year that Tiger Woods won his first major championship at the Masters. From a National Golf Foundation study, it is estimated that around 6.2 million new players took up the sport in the US in 2020, and furthermore, of those that didn't play any golf last year, 17 million of them said they are interested in taking up golf. Engagement levels with the sport are at an all-time high with over 101 million Americans having either played, watched, or read about the sport in 2020. Now, two years on from the start of the pandemic, as other activities are opening back up, the golf market is continuing to grow in 2021. This significant increase in new golfers has provided a welcome boost in sales for golf equipment companies, with sales totalling 2.81 billion USD in 2020, which is more than a 10% increase from 2019 (*Go.f Industry Facts, 2021*).

Environment

There are 3 different types of golf course, Links, Parkland and Desert. Links courses are built on sandy soil along the coastline and have a very natural aesthetic (*see Figure 2*). These courses require the golfer to play to the contours of the land. Parkland courses in comparison are much flatter and well-manicured (*see Figure 3*). They are much greener and usually lined with trees. Finally Desert courses, they are built in an area of natural desert and are constructed among the sand dunes and natural desert features (*see Figure 4*). The courses are wide open with no grass found outside of the fairway.



Figure 2. Bandon Dunes, OR. (The Golf Travel Guru, 2021)



Figure 3. Augusta National, GA. (Next Golf, n.d)



Figure 4. The Estancia Club, Phoenix, AZ. (Golf Digest, n.d)

Putting greens are the regions of very closely trimmed grass, usually less than 0.25 inches in length, on a relatively even, smooth ground surrounding the hole (*see Figure 3*). The surface is smooth and undulating to allow the golf ball to roll accurately towards the hole, but there are a number of other environmental factors that can affect the pace and direction of the ball (How Long Putting Green Grass Should Be, n.d).

For putting in particular, it is crucial to be able to discern the direction that the Bermuda blades of grass are facing. If the surface look shiny, the blades are facing away, hence making the putting surface fast. If the grass looks dark, then the blades are facing towards you and the green will be slow (Melton, 2020).



Figure 3. The Blue Course, Wigwam, Phoenix, AZ. (Wigwam Arizona, n.d)

Athlete Skills & Success

Despite the numerous external environmental factors that can affect putting performance, there are a distinct set of attributes that can be acquired by the athlete which are widely considered to improve the accuracy and reliability of putting performance. These skills include flexibility, good posture, balance, and coordination. These physical abilities are all crucial in enabling the athlete to carry out the putting stroke as effectively and successfully as possible. Focus, patience, and insight are also key psychological characteristics that can positively impact putting performance. On top of these skills, the athlete needs to execute a set of tasks:

1. Determine the pace of the green
2. Determine the gradient of the green
3. Determine the line of the putt
4. Execute pendulum putting motion



Figure 4. Aron Wise lining up putt. (Rome Sentinel, 2021)

If the athlete utilises the skills mentioned above and carries out each of these tasks, then it can be assumed that they will be able to putt successfully. Ultimate success in putting performance is achieved by getting the ball in the hole in as few shots as possible.

Initial Line Plan

The initial line plan for the proposed project includes a pair of golf shoes, a pair of socks and a pair of compression sleeves. The golf shoes will be designed to enhance foot to ground feel, with integrated midsole elements that provide direct sensory feedback to the user. The socks will be designed to work in tandem with the shoes to further enhance their midsole technology. Compression sleeves will be designed to target the golfers' wrists, providing them with positional awareness to help combat overactive hands during the putting stroke and improve swing consistency.

These products will all work together as a training aid to help further immerse the golfer in their environment, focusing their minds and making them more aware of their surroundings on the golfing green, hence improving their putting performance.

Jobs to Be Done

The proposed products will need to function as well as, or better than existing golf wear in terms of comfort and aesthetics. They will need to be durable to withstand multiple rounds of golf, as well as breathable and moisture wicking to provide a comfortable experience in hot desert environments. Since the products will be marketed as training aids, they will also need to be proven to improve putting performance.

Rules

The main rules of concern relate to both apparel and footwear worn in golf. The USGA states that apparel and footwear which incorporate design features that enhance performance cannot be worn in competitive golf (USGA, 2021).

APPAREL RULE

“Articles of clothing must not incorporate features designed to assist the player with his alignment; or that might otherwise assist the player in making a stroke or in his/her play.”

– *United States Golf Association (USGA)*

FOOTWEAR RULE

“Shoes must not incorporate features designed to assist the player in taking his stance; with his alignment; or that might otherwise assist the player in making a stroke or in his/her play.”

– *United States Golf Association (USGA)*

Product Anatomy, Materials & Manufacturing

I Golf Shoes

Golf shoes generally feature 4 main components: the upper, sock liner, midsole and outsole. (See figure 5)

The upper is designed to secure, protect, and stabilize the foot during the golf swing. It features a heel tab, heel counter, collar, tongue and strobel. The heel tab allows the shoe to be easily pulled on. The heel counter stabilizes the rearfoot. The collar adds padding to increase comfort at the lockdown point. The tongue allows the upper to move and conform to the foot. The strobel adds stability to the upper and connects the upper and midsole units.

The midsole is built to provide impact attenuation and cushioning. It keeps the foot comfortable and supports the arch throughout the round of golf. The sock liner rests on top of the midsole, and it further increases comfort at the foot bed and absorbs moisture.

The outsole is designed specifically to provide traction while walking and during the motion of the golf swing. Tread patterns can be designed to target different types of motion, providing specialised grip for different activities.



GOLF SHOES

1. UPPER - to keep foot locked in & secure
2. INSOLE - to keep foot sole comfortable
3. MIDSOLE - to cushion impact
4. OUTSOLE - to provide traction

Figure 5. Anatomy of a Golf Shoe (Brown, 2021)

In current golf footwear, the upper is most commonly made of a nylon or polyester engineered knit, or some form of synthetic leather. These knitted uppers are created using a flatbed or warp knit knitting machine to construct the upper as one singular piece. Leather uppers on the other hand are simply die cut to shape and stitched together (Motawi, 2017).

The sock liner is placed internally within the upper unit or it may be lightly glued to the top of the strobil. It is generally made of ethylene-vinyl acetate (EVA) foam with a woven polyester backing with anti-odor treatment. It is die-cut and then heat pressed into the desired shape (Motawi, 2017).

The midsole is also created from EVA foam which is moulded using an expansion press, injection moulding, or pellet expansion.

The outsole can be made from TPU or carbon rubber which is hydraulically heat pressed to create the form and then glued to the outsole unit (Motawi, 2017)

II Compression Sleeves

Compression sleeves are generally made of one singular component. However, they can be divided up into three different sections: the upper cuff, lower cuff, and the sleeve. (See *figure 6*)

The upper and lower cuff are designed to keep the product in place and prevent it from slipping during use. The sleeve itself provides targeted or graduated compression to specific locations on the arm to relieve pain or provide support to muscles.



COMPRESSION SLEEVES

1. UPPER CUFF - to prevent sleeve slipping
2. LOWER CUFF
3. SLEEVE - provide graduated compression

Figure 6. Anatomy of a Compression Sleeve (Brown, 2021)

Current compression sleeves are made from a knitted blend of polyester or nylon and spandex. The percentage of spandex integrated into the material can vary between 4% and 25% depending on the level of compression required of the product. These garments are manufactured using either a flat knit or circular knitting machine. Circular knitting manufacturing eliminates seams from the design. This seamless construction is much more desirable by consumers due to the comfort and anti-friction properties of the products that this method produces (Compression Sleeves: Everything you need to know, n.d).

III Sports Socks

Athletic socks, although technically comprised of one piece, can be segmented into 8 different sections: the cuff, the leg, the shin panel, the transfer, the heel, the instep, the sole and the toe (Patterson, 2021). (See figure 7)

The cuff is designed to prevent the product slipping down the leg. The leg and the shin panel are created to protect the shin and ankle regions and provide supportive compression. The transfer is the area of knitting transition between the leg and the instep section. The instep, the heel and the sole's main jobs are to cushion the foot, protecting it from the shoe and attenuating impact. Finally, the toe provides good fit and comfort.

Current athletic socks, much like compression sleeves, are made from a knitted blend of polyester or nylon and spandex and are manufactured using a circular knitting machine. However, these machines also now have the capability to close the toe of the sock design, creating a completely seamless structure. This seamless finish is far more comfortable and prevents friction of the foot rubbing against the seam in the shoe. (Patterson, 2021)



SPORTS SOCKS

1. CUFF - to prevent sock slipping
2. LEG
3. SHIN PANEL - to protect the shin
4. TRANSFER
5. HEEL
6. INSTEP
7. SOLE - to cushion foot
8. TOE - to provide good fit / comfort

Figure 7. Anatomy of a sock (Brown, 2021)

Competitor Analysis of State-of-The-Art Products

I Golf Shoes

There are currently no golf shoes on the market that provide direct sensory feedback from the ground to the foot sole. Three popular golf shoes on the market that have a similar product goal of improving responsiveness and ground feel have been selected to carry out a feature analysis. From this, insight should be gained into the current scope of the relevant market area and where potential product opportunities might lie. See SWOT analysis in Appendix for further analysis of components.

BRAND	PRODUCT	PRICE	FEATURES & BENEFITS
TRUE Linkswear	TRUE OG Feel 	\$145	Zero Drop Construction <ul style="list-style-type: none"> - For optimum feel and power Flexible Outsole & Upper <ul style="list-style-type: none"> - For ultimate on-course feel One-Piece Sock Knit Upper <ul style="list-style-type: none"> - For breathability Leather Saddle & Original Lacing System <ul style="list-style-type: none"> - For stability
ECCO	BIOM Hybrid 3 GTX 	\$200	Yak Leather Upper <ul style="list-style-type: none"> - For durability & breathability BIOM Natural Motion Technology <ul style="list-style-type: none"> - For flexibility & to bring you closer to the ground for improved walking motion ECCO TRI-FI Grip Outsole Zoning <ul style="list-style-type: none"> - For lateral stability, walking comfort, and rotational support GORE-TEX Construction <ul style="list-style-type: none"> - For waterproofing and breathability
G/FORE	MG4 Plus 	\$180	Footbed Nubs <ul style="list-style-type: none"> - For improved airflow & massaging effect EVA Midsole with Auxetic Sidewall <ul style="list-style-type: none"> - For comfort Moulded External Heel Cup <ul style="list-style-type: none"> - For lateral support during the swing

II Compression Sleeves

Three popular compression sleeves were selected to gain an understanding of the compression sleeve market and what specific features are desired currently by athletes from these products. In general, it seems most compression arm sleeves on the market are targeted towards relieving pain and aiding injuries rather than providing any kind of proprioceptive feedback to the athlete to improve performance. See SWOT analysis in Appendix for further analysis of components.

BRAND	PRODUCT	PRICE	FEATURES & BENEFITS
Nike	Breaking 2 Sleeve 	\$49	Engineered Mesh Structure <ul style="list-style-type: none"> - For lightweight, breathable comfort Ergonomic Left & Right Arm Design <ul style="list-style-type: none"> - For optimal comfort & fit Reflective Details <ul style="list-style-type: none"> - For visibility Seamless Construction <ul style="list-style-type: none"> - For streamlined silhouette to reduce distractions
Under Armour	Heat Gear Sleeve 	\$40	High Compression <ul style="list-style-type: none"> - For muscle recovery Targeted Compression Zones and Ribbing <ul style="list-style-type: none"> - For a revitalizing massage effect Nylon / Spandex Material <ul style="list-style-type: none"> - For moisture wicking breathability Graduated Compression <ul style="list-style-type: none"> - 20-30mmHg
Footjoy	Golf Sun Sleeve 	\$30	Soft Compression <ul style="list-style-type: none"> - For muscle protection and support during and after the game UV Protection 30+ <ul style="list-style-type: none"> - Provides protection from the summer sun Nylon/Lycra Blend Material <ul style="list-style-type: none"> - Fast drying and moisture wicking

III Sports Socks

Three popular socks used in different sports were selected to gain insight into how innovative features have been integrated into popular current sock designs. There is a market currently for socks that utilise targeted compression to increase proprioceptive response, however, they are used solely for sports such as martial arts and yoga where the socks are in direct contact with the floor, rather than a shoe. See SWOT analysis in Appendix for further analysis of components.

BRAND	PRODUCT	PRICE	FEATURES & BENEFITS
TRU	TRUSOX 3.0 	\$45	TruSox In/Ex Tech <ul style="list-style-type: none"> - Grips to foot and footwear eliminating slippage Seamless Tech Integration <ul style="list-style-type: none"> - To better allow socks to form around the unique contours of the foot
STANCE	Athletic Crew Socks 	\$10.80	Seamless Closure <ul style="list-style-type: none"> - Anti-friction finish Channelled Air Cushioning <ul style="list-style-type: none"> - Enhanced Airflow Nylon Blend <ul style="list-style-type: none"> - For breathability and comfort Targeted Mid Cushioning <ul style="list-style-type: none"> - To create barrier at critical Areas
UNDER ARMOUR	Performance Golf Sock 	\$27.99	Strategic Cushioning <ul style="list-style-type: none"> - To protect high impact zones Polyester /Nylon / Spandex Blend <ul style="list-style-type: none"> - For breathability and moisture wicking properties Engineered Ribbing <ul style="list-style-type: none"> - For added comfort

To gain further understanding of these competitor products currently on the market, an in-depth swot analysis of each has been carried out. Each analysis has been

divided into the product's individual anatomical parts to ensure thorough exploration. This analysis can be found in the appendix.

Intellectual Property Analysis

Relevant intellectual property to this research includes patents that relate to articles of apparel providing enhanced body positional feedback using compression zones. As well as patents that relate to footwear that provide sensory tactile feedback through textured sole and footbed structures.

Relevant patents within the footwear space that incorporate footbed textures and sensory elements to provide proprioceptive feedback:

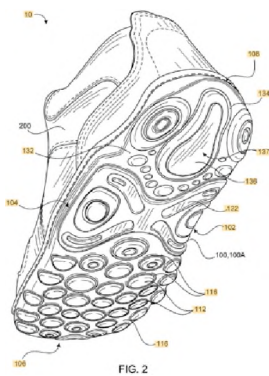


Figure 8.

- Articles of Footwear – U.S. Patent No. 8333022 B2 (*Crowley et al., 2016*) SRL LLC.

This patent details a footbed that promotes complimentary movement and proprioceptive feedback of a user's foot (e.g., to help an adult balance on an uneven surface) while wearing the article of footwear.

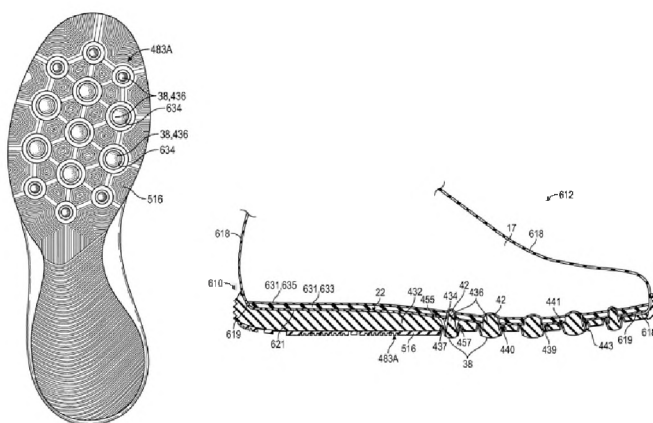


Figure 9.

- Sole Structure with Proprioceptive Elements and Method of Manufacturing a Sole Structure – U.S. Patent No. 10798993 B2 (*Chen et al., 2018*) NIKE

This patent details a sole structure for an article of footwear that comprises a midsole body having a proximal surface and a distal surface. Proprioceptive elements extend in the hole in the midsole body, and translate toward the proximal surface in the holes upon a force directed along a central axis of the hole at a distal end of the proprioceptive elements. (*Chen et al., 2018*)

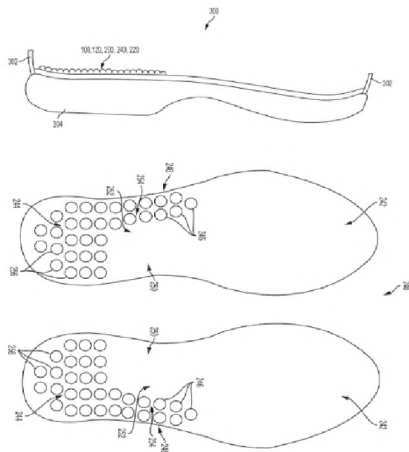


Figure 10.

- Selectively Textured Footbed – U.S. Patent No. 10542790 B2 (*Kazarian, 2015*)

This patent details a footbed which includes a rear foot portion with a plurality of discrete raised areas extending from the rear foot portion. The discrete raised areas are constructed and arranged to engage a rear foot region of a plantar surface of a foot. The foot-beds provide a sensory input to the plantar surface to allow a user to determine whether and/or how to adjust his or her gait. (*Kazarian, 2015*)

Relevant patents within the apparel space that provide positional body feedback:

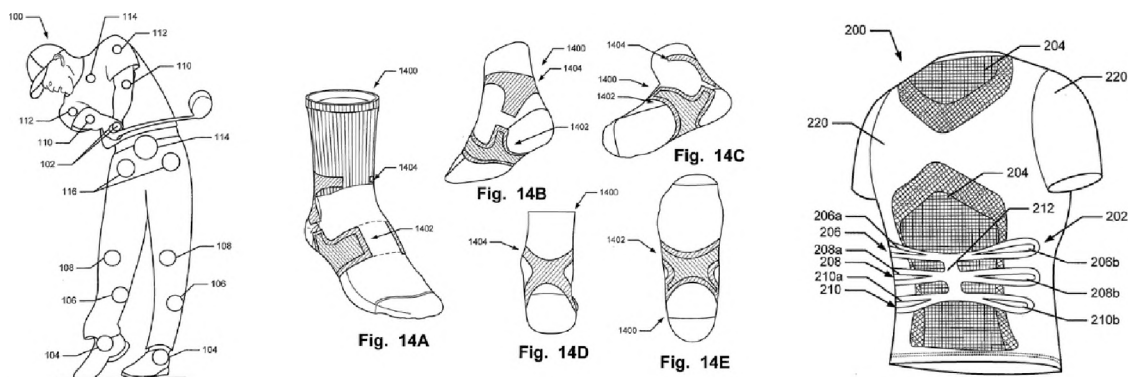


Figure 11. METHODS OF CREATING PROVIDING ENHANCED BODY POSITION FEEDBACK TO A USER. U.S. PATENT NO. 2008150655 A1 (*Nordstrom et al., 2008*) NIKE

This patent details a garment structure that has one or more fabric elements structured and arranged to provide a close fit to at least one predetermined portion of a body (e.g. area of the body for which enhanced position sensing and feedback are desired, such as the lower back, the arch of the foot.) (Nordstrom et al., 2008)

Future Aesthetic Trends

All trend research relates to the spring and summer season of 2022 and 2023. The proposed footwear and apparel golf products intend to launch during this time span.

I Graphic Trends

The lo-fi sports concept will be the primary graphic trend for golf during the specified season (see figure 12). Due to the increase in individuals taking up new sports amid the covid pandemic, people have been adopting the ‘give is a go’ mentality. This lo-fi trend caters to newcomers and doesn’t take itself too seriously. The concept is all about being inclusive and welcoming to amateurs and pros alike. Embodying a 90’s vintage sense of styling through printing simple slogans and tongue and cheek graphics (Watkins, 2021). A key driver for this lo-fi sports trend is the *Anti Country Club*. This Tokyo based brand is an advocate for inclusion and diversity in outdoor-wear and sportswear (ACC, n.d). Its aim is to break down stereotypes associated with old-school golf culture.



Figure 12. Graphic trends for Spring & Summer seasons 22/23. (Brown, 2021)

Another graphic trend set to move its way into the golf sportswear scene is ‘information overload’ (See figure 12). This trend utilises graphics themselves as a means of

communication for educating wears and telling stories as users begin to demand more meaningful sportswear (Watkins, 2021). McQ is headlining this trend as he teamed up with designer Tom Ducarouge to create a range of clothing that illustrates how to breathe more consciously through printed and embossed infographics (Smith, n.d). These graphics communicate through both visual and tactile means creating a sensory, explorative product.

II Logo / Branding Trends

Branding and logo trends will play on a maxi-minimalist concept. With bold logos taking centre stage and becoming the main graphic feature of the product, but being integrated in simple, more subtle ways. For example, embossing and engineered knit logos integrate branding seamlessly. They create bold features in a minimal, monotone fashion with tactile qualities (*see figure 13*).



Figure 13. Branding/logo trends for Spring & Summer seasons 22/23.
(Brown, 2021)

III Colour Trends

Inspired by the natural tones of the golf course environment, a mix of classic, neutral browns and bright optic white embody a sense of calm and golfing tradition. They are in keeping with the country club, 90's preppy sports theme expected to remain important throughout S/S 23 (Paget, 2021). Accent colours introduce a modern twist, highlighting the bright floral colours of the Arizonian desert. Greens and pinks introduce a smart but sporty look to the classic palette. (*See figure 14*)



Figure 14. Colour trends for Spring & Summer seasons 22/23. Includes CMYK colour codes. (Brown, 2021)

The Physiology of a Golfer

Unlike most sports, there is no typical physiology that definitively makes an individual perform best at golf. The sport does not require an athlete to be a certain height or weight or generate a certain amount of force. This is one of the reasons why the sport is so popular. Almost anyone can participate despite their age or athletic ability. Even at a professional level this can be demonstrated. Some athletes are young, strong, and tall, while others are older, weaker, and shorter. It has been proven that there is no significant correlation between anthropometric measures and golfing performance (Brink, 2018). This emphasizes the significance of golfing technique, experience and mental strength in the game of golf. Although still both physically and mentally demanding, the level of physical strain involved can be determined by the individual. For example, golf carts or caddies can be used to reduce the physical aspect of the game, as well as this, golf swings and equipment can be adjusted as people age and their muscles begin to weaken.

There is, however, a strong correlation that can be observed between certain physiological factors and improvement in golfing performance. Despite the fact that golf is not a high intensity sport, it does still require the athlete to maintain performance levels over the entirety of an 18-hole round. This can take up to 5 hours and span over a distance of 10 kilometres (Brink, 2018). Therefore, an athlete's aerobic capacity can affect how well they are able to perform in terms of endurance over the course of a round of golf. Aerobic capacity is the ability of the heart and lungs to get oxygen to the muscles, and it is evaluated by

determining how much oxygen an athlete uses while exercising (Reents, 2019). In other words, this is known as ‘oxygen uptake’ or VO₂ max. For an age group of 18 – 35 year-olds, a good VO₂ max for an average golfer would be considered to lie somewhere between 44-51 ml/kg/min for male players, and 33-37ml/kg/min for women (Capritto, 2019).

One of the biggest physiological factors affecting golfing performance is both upper and lower body muscular strength. This is because the motion of the golf swing requires repetitive and intense short bursts of energy. The motion of the swing also favours flexibility and balance as they help the athlete to generate momentum, hence producing more power and distance of the golf ball (Brink, 2018). Typically, a player will maximally recruit 30lbs of muscle to generate four horsepower during the golf swing. This equates to around 900kg of force being applied to the ball in half a millisecond at impact, an action that is repeated multiple times in a round of golf (Greg D. Wells, 2009).



Figure 15. Kevin Tway golf swing. (Kaspriske, 2019)

Perhaps the most important factor that can affect golfing performance, is an individual’s proprioceptive response. This is the athlete’s ability to sense, interpret and react to relevant external stimuli. This includes for example, being able to perceive distance, textures, undulation, and weather conditions and then respond to them appropriately.

Biomechanics of The Putting Stroke

The biomechanical motion of the putting stroke is relatively simple in comparison to the full swing action. It utilises fewer muscles and joints and involves significantly less motion. Despite this, the action of putting remains arguably the most difficult aspect of golf. There are three main reasons why this is the case:

1. The minimal amount of motion and precise nature of the stroke
2. The significant effect of external stimuli
3. Performance anxiety

The minimal amount of motion involved in the putting stroke makes consistency difficult to achieve. The stroke involves keeping most of the body fixed in position while isolating the relevant muscle group used to initiate the putting action. A lot of individuals struggle to isolate the movement of specific muscles without causing motion in other areas of the body.

The putting stroke set up involves the athlete standing with their feet shoulder width apart and knees slightly flexed. Their back should be straight and bent over at the hip joint with their left eye looking directly down over the ball. Their hands should loosely grip the putter so that the putter becomes a continuation of their forearms. Elbows should be slightly flexed and hang beneath their shoulders. (See figure 16)



Figure 16. Putting Stroke Set Up Position. (Putting Stance & Ball Position, n.d)

Once the athlete has engaged their muscles to remain fixed in this set up position, they isolate their deltoid muscles to carry out the stroke itself (See figure 17). The deltoid muscle is the triangular muscle forming the rounded contour of the shoulder, and the outer part of the upper arm, as it passes up and over the shoulder joint (The Role of Deltoids in the golf Swing, n.d). The back stroke is carried out by engaging their right deltoid muscle to rock their hands, arms, and shoulders backwards as one. Then they switch to engage their left deltoid muscle to bring their hands, arms, and shoulders down and forward through the ball in a pendulum motion (The biomechanics of a simple putting stroke, 2018). (See figure 18)



Figure 17. Deltoid Muscle Group. (The Role of Deltoids in the golf Swing, n.d)



Figure 18. Putting Stroke Pendulum Motion. (Putting Stance & Ball Position, n.d)

One of the most common issues golfers struggle with when putting are overactive hands. This is when the golfer flexes at the wrist joint, rather than keeping it stiff during the pendulum motion. It causes their hands to trail behind the ball, leaving the face of the putter open at impact, generating an inconsistent stroke, and making their putts inaccurate (The biomechanics of a simple putting stroke, 2018). (See figure 19)

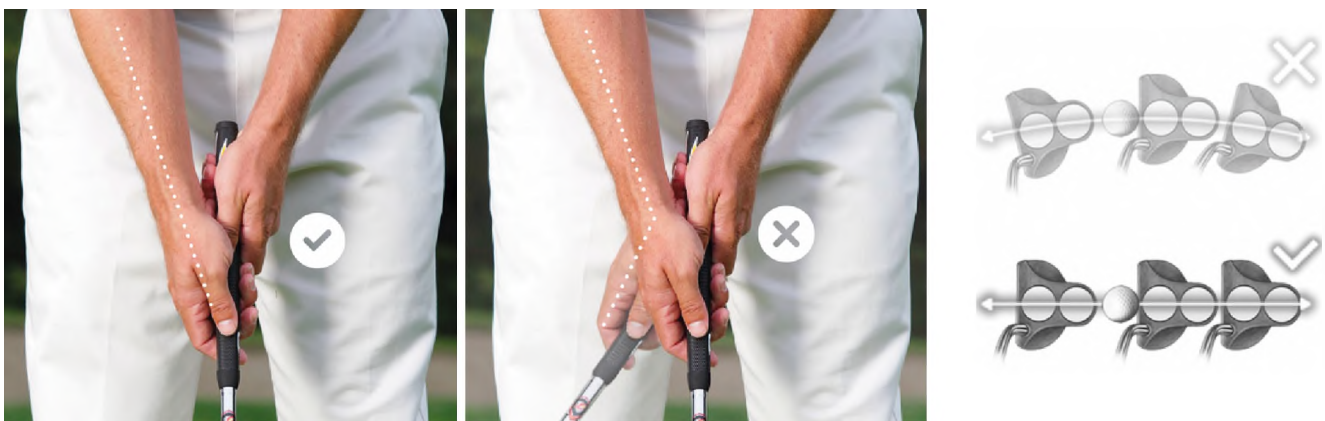


Figure 19. Visualization of overactive wrists and club face interference. (Brown, 2021)

The Psychology of Golf

I Putting

As well as physical struggles, there are mental hurdles to overcome when it comes to putting effectively. Having the right mindset and ability to perform under pressure is vitally important. Pressure occurs when there is a perceived success or failure of an event that hasn't happened yet (Mackenzie, 2019).

In the case of putting, this is thinking too much about what the outcome of that putt will mean for you in the future and allowing pressure to build which affects your focus and your stroke. These speculative thoughts about the future outcome will do two things:

1. Distract you from what you need to do to maximise your chances of making the putt
2. Cause Performance Anxiety (Increased heart rate, less focus, more tension in the hands, arms, and shoulders)

Golfers that can play their best most consistently are those that are able to keep their emotions in check and concentrate for prolonged periods of time. They are also confident in their abilities and are motivated to practice and continuously improve their skillset. Concentration is one of the most important skills required to improve putting performance. This is the athlete's ability to exclude all unnecessary stimuli, allowing them to focus solely on the task at hand. Golfers practice effective concentration on putting greens by:

1. Focusing on a singular visual point
2. Implementing a pre-shot routine
3. Being more present and sensing their surroundings



Figure 20. Lexi Thompson Reading a Putt. (Charles, 2019)

Golfers become more present in their surroundings by focusing on their breathing and their senses. This helps them to get out of their head and become more externally focused, which distracts them from any speculation of the future which could interfere with the process of their putting stroke (Mackenzie, 2019).

II The Environment

As well as enabling an athlete to better channel their focus, becoming more aware of their surrounding environment can provoke other positive psychological effects on a player. During the recent pandemic people have been craving green outdoor spaces and this is one of the reasons why such an uptake in golf has been seen over the past couple of years. It has been proven that contact with nature slows down stress responses and induces calm (Golf, n.d). Many visual, natural features that help people to relax and destress are also found on golf courses: these features include (*See figure 21*):



Figure 21. Relaxing Visual Features Found on Golf Courses. (Golf, n.d)

Water: Green spaces with water have an added benefit with increased opportunities for curiosity and fascination.

Biodiversity: A richer natural environment has an important impact on the restorative health experience.

Spatial Variety: Landforms, undulation, and the way the terrain changes stimulate our fascination and curiosity, including the shaping of holes and fairways.

Light Patterns: The way light filters through trees and is cast across the ground triggers physiological and mental processes

III Marketing

The superstitious belief that using a professional's equipment will improve one's own performance is very popular among amateur athletes. This particular belief may be more than just a superstition, however. According to a 2011 study, amateur golfers who believed they were using a professional golfer's putter not only sunk 32% more putts than others, but also perceived the hole to be bigger. These results provide empirical support for anecdotes, which allege that using objects with positive contagion can improve performance, and further suggest perception can be modulated by positive contagion (Lee, 2011).

Positive contagion is an example of social psychology. It's the belief that brief contact with an object can lead to the permanent transfer of certain properties to another object. In the case of sporting equipment, contagion is believed to have positive effects, but it can also have negative ones, too. For example, it has been shown that if a particular product has been used by unpopular person, it can become less desirable to the consumer (Costandi, 2011).

There are several explanations as to why positive contagion is able to influence putting performance so significantly. Firstly, the belief of some participants that they were using Curtis's putter may have encouraged them to use **positive mental imagery** associated with his past successes. Another possibility is what is referred to as **priming**: believing the putter was once used by a professional could have led the participants to entertain the concept of "skill". Finally, the results could be explained by **object valuation**, which can have a powerful placebo effect. For example, expensive wines are perceived to taste better than cheaper ones. Thus, the belief that one is using a professional's putter could enhance one's own perceived putting capabilities in a similar way (Costandi, 2011).

Research Plan

The Project Statement:

How might we design shoes / apparel for male golfers that work passively together as a training aid to heighten proprioception, and thus improve putting performance?

I Collection of Data to Determine Project Viability

Over the next few months, the project goal is to answer the following questions through extensive primary research methods.

1. Does improving putting performance merit product intervention?
2. How can I make my products desirable by my target market?
3. What are the footwear / apparel needs for desert golf environments?

4. What are the differences between the behaviour of amateur vs professional golfers when putting on a green?
5. What are the differences between the needs of amateur vs professional golfers when putting on a green?

A questionnaire has been developed to collect information relevant to these questions. The content of the questionnaire *to investigate consumer desire for training aids and performance needs of the specified product intervention* can be found within the Appendix. The results of the questionnaire will be important in verifying that golfers are interested in footwear and apparel that act as training aids to provide sensory feedback and improve putting performance.

II Competitor Product Performance Testing Plans

To determine a baseline for where the proposed product line of footwear and apparel should fall in terms of performance, function and aesthetics, competitor products will be purchased, tested and analysed. Five competitor products have been chosen. See table below.

Brand	Golf Shoes	Price	Size	Colourway
True Linkswear	True OG Feel	\$145	M12	Varsity White / Navy
G/Fore	MG 4 Plus	\$185	M12	Snow
	Compression Sleeves			
Under Armour	Heat Gear Sleeve	\$40	S/M	Black
Footjoy	Sun Sleeves	\$30	S/M	White
	Socks			
Tru Sox	3.0 Ankle Thin	\$27.80	L	White
Under Armour	Performance Golf			Multipack

These products will be tested to determine their effect on general golfing performance and putting performance, as well as to highlight in what areas these products are perhaps lacking or excelling in terms of aesthetics, comfort, and overall feel. Product testing will be performed firstly in Oregon, for convenience, and then Phoenix Arizona. The Phoenix testing will assess the performance of the products in warmer environmental conditions. Five male golfers have been recruited as wear testers for this analysis, all of which are a similar height and build.

To analyse golfing performance, the wear testers will be observed and analysed over the duration of an 18 hole round of golf. They will be interviewed about the product features before and after the round and observed throughout. They will be supplied with a personal notebook and asked to take notes during the round of anything worth mentioning. To analyse golfing performance in a more randomized environment, the wear testers will also be asked

to perform multiple random golf shots at a driving range while wearing the products. Observation and analysis of performance will be noted.

Finally, putting performance will also be tested in a controlled environment to limit external factors affecting the wearers performance. The wearers will be asked to perform various putts from different locations and their performance will be monitored. Video analysis of their putting strokes will also be taken throughout the testing. See the appendix for more specific details on the testing methods being used and performance metrics being taken.

Winter Term Review

Please refer to the appendix for a copy of the slides from the winter term review. They illustrate the project design process from initial ideation, to prototyping, and testing.

Spring Term Review

Please refer to the appendix for a copy of the slides from the spring term review. This term consisted of refining the story behind the project, finalizing the design, and developing a strong aesthetic brand for the collection, as well further prototyping, testing, and project validation.

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APPENDIX

A

Swot Analysis of Competitor Products



TRUE OG FEEL	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
UPPER	<ul style="list-style-type: none"> ONE PIECE SOCK STRUCTURE BREATHABLE FABRIC WIDE TOE BOX SUPPORTIVE LEATHER SADDLE 	<ul style="list-style-type: none"> HARD FOR WIDE FEET TO PULL ON LEATHER SADDLE NOT BREATHABLE 	<ul style="list-style-type: none"> A BREATHABLE SADDLE MATERIAL INNOVATIVE LACING SYSTEM 	<ul style="list-style-type: none"> SHOES WITH WIDER SOCK KNIT UPPER MAY BE MORE DESIRABLE
SOCK LINER	<ul style="list-style-type: none"> CHEAP 	<ul style="list-style-type: none"> FLAT, NO SHAPE 	<ul style="list-style-type: none"> MORE ERGONOMICALLY SHAPED SURFACE 	<ul style="list-style-type: none"> SOCK LINERS WITH ACTUAL PERFORMANCE ADVANTAGES ARE PREFERABLE
MIDSOLE	<ul style="list-style-type: none"> ZERO DROP IMPROVES GROUND FEEL 	<ul style="list-style-type: none"> FLAT MIDSOLE MAY NOT PROVIDE ENOUGH SUPPORT FOR HIGH ARCHED FEET 	<ul style="list-style-type: none"> MIDSOLE WITHOUT ZERO DROP THAT INCREASES GROUND FEEL 	<ul style="list-style-type: none"> MORE SUPPORTIVE MIDSOLES MAY BE MORE COMFORTABLE AND DESIRABLE FOR PLAYERS WITH HIGHER ARCHES OR PROBLEMATIC FEET
OUTSOLE	<ul style="list-style-type: none"> FLEXIBLE MATERIAL DEEP TREAD PROVIDES TRACTION 	<ul style="list-style-type: none"> NO SPIKES NO VARIATION IN TREAD SHAPE/SIZE - SAME OVER ENTIRE SOLE DEEP TREAD REDUCES GROUND FEEL 	<ul style="list-style-type: none"> ZONED TREAD PATTERN THAT VARIES ACROSS THE SOLE ADDITION OF SPIKES 	<ul style="list-style-type: none"> SHOES WITH SPIKES HAVE SUPERIOR TRACTION IN WET WEATHER



BIOM HYBRID 3 GTX	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
UPPER	<ul style="list-style-type: none"> VERSATILITY - LOOKS LIKE A SNEAKER WATERPROOF 	<ul style="list-style-type: none"> YAK LEATHER - NOT BREATHABLE OR SUSTAINABLE 	<ul style="list-style-type: none"> LOOK INTO VEGAN ALTERNATIVES MAKING LEATHER MORE BREATHABLE 	<ul style="list-style-type: none"> VEGAN, MORE BREATHABLE ALTERNATIVES ARE MORE DESIRABLE, ESPECIALLY FOR DESERT ENVIRONMENTS
SOCK LINER	<ul style="list-style-type: none"> ORTHOLITE - RECYCLED REMOVABLE TO PROVIDE MORE WIDTH VERY SUPPORTIVE WASHABLE 	<ul style="list-style-type: none"> NO ALTERNATIVES FOR THOSE WITH WIDER FEET 	<ul style="list-style-type: none"> INSOLE SIZE OPTIONS TRANSFORMABLE INSOLE 	<ul style="list-style-type: none"> SHOES THAT PROVIDE A RANGE OF INSOLE SIZES OR A WIDER TOE BOX DESIGN ARE MORE DESIRABLE
MIDSOLE	<ul style="list-style-type: none"> COMFORTABLE 	<ul style="list-style-type: none"> FLAT, NO SHAPE OR POINT OF INTEREST PLAIN 	<ul style="list-style-type: none"> MORE INTERESTING, PERFORMANCE ENHANCING TECHNOLOGY 	<ul style="list-style-type: none"> MIDSOLES WITH INTEGRATED TECHNOLOGY THAT IMPROVES PERFORMANCE ARE MORE DESIRABLE
OUTSOLE	<ul style="list-style-type: none"> 3 ZONE SYSTEM GREAT TRACTION DURING SWING FLEXIBLE 	<ul style="list-style-type: none"> NO SPIKES LACK OF BACK/FORWARD TRACTION WHEN WALKING - SLIPPING TRACTION ONLY DESIGNED TO AID SWING MOTION 	<ul style="list-style-type: none"> IMPROVE TRACTION IN ALL DIRECTIONS FOR ALL MOTION 	<ul style="list-style-type: none"> SHOES WITH SPIKES PROVIDE SUPERIOR TRACTION DURING THE GOLF SWING



MG4 PLUS

	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
UPPER	<ul style="list-style-type: none"> 100% WATERPROOF VERY MODERN AESTHETIC VERSATILE - LOOKS LIKE A SNEAKER 	<ul style="list-style-type: none"> UNISEX SIZING NOT BREATHABLE 	<ul style="list-style-type: none"> PROVIDE BOTH MALE / FEMALE DESIGNS 	<ul style="list-style-type: none"> SHOES WITH KNITTED UPPER ARE MORE DESIRABLE FOR SUMMER GOLF CONDITIONS
SOCK LINER	<ul style="list-style-type: none"> MASSAGING NUB TEXTURES PROVIDE AIRFLOW WASHABLE 	<ul style="list-style-type: none"> TEXTURE COULD PRODUCE STRANGE / DISTRACTING SENSATION 	<ul style="list-style-type: none"> UTILISE TEXTURED SURFACE FOR PROPRIOCEPTIVE REASONS, NOT JUST AIRFLOW FIND BALANCE BETWEEN EFFECTIVE BUT NOT UNCOMFORTABLE 	<ul style="list-style-type: none"> SHOES WITH SMOOTHER INSOLES MAY BE MORE DESIRABLE FOR SOME PLAYERS TEXTURED SENSATION IS PERSONAL PREFERENCE
MIDSOLE	<ul style="list-style-type: none"> AUXETIC LATTICE STRUCTURE PROVIDES REBOUND VISUALLY STANDS OUT / ATTRACTIVE 	<ul style="list-style-type: none"> SHOULD REBOUND BE THE PRIMARY MIDSOLE CONCERN FRO GOLF? 	<ul style="list-style-type: none"> LATTICE STRUCTURE THAT SUPPORTS & IMPROVES GROUND FEEL - NOT JUST GOOD FOR REBOUND 	<ul style="list-style-type: none"> SHOES THAT CONCENTRATE MORE ON SUPPORT AND COMFORT ARE MORE DESIRABLE FOR GOLF WEAR
OUTSOLE	<ul style="list-style-type: none"> VERSATILE - CAN BE WORN ANYWHERE 2 TYPES - KNURLED & SAW TOOTH TRACTION 	<ul style="list-style-type: none"> NO SPIKES VERY LITTLE / NO ZONING PATTERN 	<ul style="list-style-type: none"> REMOVEABLE SPIKED SYSTEM TO ALLOW SHOES TO BE WORN ANYWHERE MULTIPLE TYPES OF TRACTION INTEGRATED INTO A SYSTEM 	<ul style="list-style-type: none"> SHOES WITH SPIKES PROVIDE BETTER TRACTION IN COURSE TURF

3



UNDER ARMOUR PERFORMANCE GOLF

	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
LEG	<ul style="list-style-type: none"> HEEL PULL TAB CHANNELED AIR CUSHIONING PROVIDES BREATHABILITY 	<ul style="list-style-type: none"> SLIPS 	<ul style="list-style-type: none"> ANTI SLIP CUFF 	<ul style="list-style-type: none"> SOCKS WITH ANTI-SLIP FEATURE ARE MORE DESIRABLE FOR SPORTS
ANKLE	<ul style="list-style-type: none"> SEAMLESS - NO FRICTION 	<ul style="list-style-type: none"> NO COMPRESSIVE SUPPORT 	<ul style="list-style-type: none"> APPLY SUPPORT TO IMPROVE LATERAL & ROTATIONAL STABILITY 	<ul style="list-style-type: none"> SOCKS WITH SUPPORT AROUND THE AKLE ARE MORE DESIRABLE FOR ROTATIONAL MOTIONS
HEEL	<ul style="list-style-type: none"> CUSHIONING PROVIDES IMPACT PROTECTION 	<ul style="list-style-type: none"> CUSHIONING REDUCES BREATHABILITY DOES CUSHIONING ADVANCE UP HIGH ENOUGH? 	<ul style="list-style-type: none"> CONTINUE CUSHIONING FURTHER UP BACK OF LEG 	<ul style="list-style-type: none"> SOCKS WITH LESS CUSHIONING MAY BE MORE BREATHABLE
INSTEP	<ul style="list-style-type: none"> CHANNELED AIR CUSHIONING PROVIDES BREATHABILITY 	<ul style="list-style-type: none"> NO OVER ARCH SUPPORT NO PROTECTION FROM PRESSURE OF LACES/ TONGUE 	<ul style="list-style-type: none"> INTEGRATE CUSHIONING TO PROTECT FROM UPPER CONTINUE CHANNELED AIR CUSHIONING ALL ROUND 	<ul style="list-style-type: none"> SOCKS WITH OVER ARCH SUPPORT ARE BETTER FOR INTENSE SPORT
SOLE	<ul style="list-style-type: none"> COMPRESSION SUPPORT UNDER ARCH RIBBED CUSHIONING FOR IMPACT PROTECTION 	<ul style="list-style-type: none"> CUSHIONING REDUCES BREATHABILITY & GROUND FEEL 	<ul style="list-style-type: none"> FIND BALANCE BETWEEN CUSHIONING AND STILL ALLOWING GROUND FEEL 	<ul style="list-style-type: none"> SOLES WITH MINIMAL CUSHIONING CAN IMPROVE FEEL AND BALANCE
TOE	<ul style="list-style-type: none"> SEAMLESS CLOSURE PREVENTS FRICTION CUSHIONING FOR IMPACT PROTECTION 	<ul style="list-style-type: none"> CUSHIONING REDUCES BREATHABILITY 	<ul style="list-style-type: none"> FIND BALANCE BETWEEN CUSHIONING AND STILL ALLOWING GROUND FEEL 	<ul style="list-style-type: none"> SOCKS WITH LESS CUSHIONING ARE MORE BREATHABLE IN WARMER CONDITIONS

S.W.O.T ANALYSIS

SOCK

1



ATHLETIC CREW SOCK

2

	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
LEG	<ul style="list-style-type: none"> HITS MID POINT OF LOWER LEG CHANNELED AIR CUSHIONING PROVIDES BREATHABILITY 	<ul style="list-style-type: none"> SLIPS 	<ul style="list-style-type: none"> SHORTER SOCK THAT STILL COVERS ANKLE ANTI SLIP CUFF 	<ul style="list-style-type: none"> SOCKS WITH ANTI-SLIP FEATURE ARE MORE DESIRABLE FOR SPORTS
ANKLE	<ul style="list-style-type: none"> SEAMLESS - NO FRICTION 	<ul style="list-style-type: none"> NO COMPRESSIVE SUPPORT 	<ul style="list-style-type: none"> APPLY SUPPORT TO IMPROVE LATERAL & ROTATIONAL STABILITY 	<ul style="list-style-type: none"> SOCKS WITH SUPPORT AROUND THE ANKLE ARE MORE DESIRABLE FOR ROTATIONAL MOTIONS
HEEL	<ul style="list-style-type: none"> CUSHIONING PROVIDES IMPACT PROTECTION 	<ul style="list-style-type: none"> CUSHIONING REDUCES BREATHABILITY DOES CUSHIONING ADVANCE UP HIGH ENOUGH? 	<ul style="list-style-type: none"> CONTINUE CUSHIONING FURTHER UP BACK OF LEG 	<ul style="list-style-type: none"> SOCKS WITH LESS CUSHIONING MAY BE MORE BREATHABLE
INSTEP	<ul style="list-style-type: none"> CHANNELED AIR CUSHIONING PROVIDES BREATHABILITY 	<ul style="list-style-type: none"> NO OVER ARCH SUPPORT NO PROTECTION FROM PRESSURE OF LACES/ TONGUE 	<ul style="list-style-type: none"> INTEGRATE CUSHIONING TO PROTECT FROM UPPER CONTINUE CHANNELED AIR CUSHIONING ALL ROUND 	<ul style="list-style-type: none"> SOCKS WITH OVER ARCH SUPPORT ARE BETTER FOR INTENSE SPORT
SOLE	<ul style="list-style-type: none"> COMPRESSION SUPPORT UNDER ARCH RIBBED CUSHIONING FOR IMPACT PROTECTION 	<ul style="list-style-type: none"> CUSHIONING REDUCES BREATHABILITY & GROUND FEEL 	<ul style="list-style-type: none"> FIND BALANCE BETWEEN CUSHIONING AND STILL ALLOWING GROUND FEEL 	<ul style="list-style-type: none"> SOLES WITH MINIMAL CUSHIONING CAN IMPROVE FEEL AND BALANCE
TOE	<ul style="list-style-type: none"> SEAMLESS CLOSURE PREVENTS FRICTION CUSHIONING FOR IMPACT PROTECTION 	<ul style="list-style-type: none"> CUSHIONING REDUCES BREATHABILITY 	<ul style="list-style-type: none"> FIND BALANCE BETWEEN CUSHIONING AND STILL ALLOWING GROUND FEEL 	<ul style="list-style-type: none"> SOCKS WITH LESS CUSHIONING ARE MORE BREATHABLE IN WARMER CONDITIONS



TRUSOX 3.0

3

	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
LEG	<ul style="list-style-type: none"> EXTERNAL & INTERNAL GRIPS TO PREVENT SLIPPING IDENTIFIABLE BRANDING 	<ul style="list-style-type: none"> OFTEN CUT OFF BY PLAYERS - SO NEVER USED WHY IS EXTERNAL GRIP NEEDED HERE? 	<ul style="list-style-type: none"> RESEARCH INTO OPTIMUM LENGTH OF SOCK LEG ADJUSTABLE SOCK LENGTH 	<ul style="list-style-type: none"> SOCKS THAT DON'T REQUIRE SELF MODIFICATIONS ARE EASIER AND LESS WORK
ANKLE	<ul style="list-style-type: none"> MORE BREATHABLE KNIT STRUCTURE 	<ul style="list-style-type: none"> NO LATERAL SUPPORT 	<ul style="list-style-type: none"> TARGETED COMPRESSIVE SUPPORT FOR SPECIFIC SPORT MOTIONS 	<ul style="list-style-type: none"> SOCKS WITH ANKLE SUPPORT ARE PREFERABLE FOR INTENSE SPORTS
HEEL	<ul style="list-style-type: none"> EXTERNAL & INTERNAL GRIPS TO PREVENT SLIPPING 	<ul style="list-style-type: none"> HOW WOULD GRIPS LAST IN WASH? VERY LITTLE CUSHIONING 	<ul style="list-style-type: none"> TECHNOLOGY THAT LASTS WASH AFTER WASH 	<ul style="list-style-type: none"> SOCKS THAT LAST MULTIPLE WASHES ARE BETTER VALUE TO CONSUMERS
INSTEP	<ul style="list-style-type: none"> COMPRESSIVE SUPPORT OVER ARCH MORE BREATHABLE KNIT STRUCTURE 	<ul style="list-style-type: none"> THIN WITH LITTLE PROTECTION 	<ul style="list-style-type: none"> TARGETED INSTEP CUSHIONING 	<ul style="list-style-type: none"> INSTEPS WITH MORE CUSHIONING ARE MORE PROTECTIVE AND COMFORTABLE
SOLE	<ul style="list-style-type: none"> EXTERNAL & INTERNAL GRIPS TO PREVENT SLIPPING COMPRESSIVE UNDER ARCH 	<ul style="list-style-type: none"> HOW WOULD GRIPS LAST IN WASH? 	<ul style="list-style-type: none"> NUBS THAT PROVIDE ROTATIONAL SUPPORT & STABILITY DURING GOLF SWING 	<ul style="list-style-type: none"> SOCKS THAT LAST MULTIPLE WASHES ARE BETTER VALUE TO CONSUMERS
TOE	<ul style="list-style-type: none"> CUSHIONED 	<ul style="list-style-type: none"> NOT SEAMLESS - POINT OF STRESS - CAUSING BLISTERS 	<ul style="list-style-type: none"> SEAMLESS TOE BOX OTHER BLISTER PREVENTION TECHNOLOGY 	<ul style="list-style-type: none"> SEAMLESS CONSTRUCTION SOCKS ARE MORE COMFORTABLE AND PREVENT FRICTION



BREAKING 2

	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
UPPER CUFF	<ul style="list-style-type: none"> SEAMLESS IMPROVES COMFORT 	<ul style="list-style-type: none"> SLIPPAGE 	<ul style="list-style-type: none"> ANTI-SLIP FEATURE 	<ul style="list-style-type: none"> CUFFS THAT DON'T SLIDE DOWN ARE MORE DESIRABLE AND COMFORTABLE TO WEAR
LOWER CUFF	<ul style="list-style-type: none"> SEAMLESSNESS IMPROVES COMFORT 	<ul style="list-style-type: none"> CUFFS CAN BE DISTRACTING / IRRITATING - ESPECIALLY BENEATH OTHER CLOTHING 	<ul style="list-style-type: none"> WHY IS CUFF NEEDED HERE? INVESTIGATE MATERIAL INTERACTION WITH CLOTHING 	<ul style="list-style-type: none"> CUFFS THAT DON'T INTERFERE WITH GLOVES / WATCHES ETC. ARE LESS DISTRACTING
SLEEVE	<ul style="list-style-type: none"> DYNAMIC / ATTRACTIVE AESTHETIC IDENTIFIABLE BRANDING SEAMLESS CONSTRUCTION REDUCES DRAG BREATHABLE ERGONOMIC LEF / RIGHT 	<ul style="list-style-type: none"> PURELY FOR AERODYNAMIC PERFORMANCE NO GRADUAL COMPRESSION 	<ul style="list-style-type: none"> TARGETED COMPRESSION ZONES TO PROVIDE SPECIALIZED SPORT FEEDBACK 	<ul style="list-style-type: none"> SLEEVES WITH TARGETED COMPRESSION ZONING FOR SPECIFIC SPORTS ARE MORE EFFECTIVE AND HELPFUL

1



S.W.O.T ANALYSIS
COMPRESSION SLEEVE

FOOTJOY SUN SLEEVES

	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
UPPER CUFF	<ul style="list-style-type: none"> SEAMLESS 	<ul style="list-style-type: none"> SLIPPAGE 	<ul style="list-style-type: none"> RESEARCH INTO OPTIMUM SLEEVE LENGTH 	<ul style="list-style-type: none"> SLEEVES WITH NON SLIP FUNCTION ARE MORE DESIRABLE
SLEEVE	<ul style="list-style-type: none"> SEAMLESS TARGETED COMPRESSION COMFORTABLE 	<ul style="list-style-type: none"> LOOKS LIKE A MEDICAL COMPRESSION SLEEVE 	<ul style="list-style-type: none"> MORE ATHLETIC PERFORMANCE APPEARANCE 	<ul style="list-style-type: none"> SLEEVES THAT LOOK MORE AESTHETICALLY DESIRABLE
LOWER CUFF	<ul style="list-style-type: none"> SEAMLESS 	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> EXTEND DOWN OVER WRIST JOINT 	<ul style="list-style-type: none"> N/A

2



S.W.O.T ANALYSIS

COMPRESSION SLEEVE

3

UNDER ARMOUR HEAT GEAR SLEEVE

	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
UPPER CUFF	<ul style="list-style-type: none"> ELASTICATED TO ALLOW STRETCH AND MOBILITY 	<ul style="list-style-type: none"> SEAMS CAN CAUSE FRICTION & BLISTERS SLIPPAGE STOPS MID BICEP - THIS COULD CAUSE DISCOMFORT OR EVEN DAMAGE MUSCLE 	<ul style="list-style-type: none"> SEAMLESS CONSTRUCTION RESEARCH MOST EFFECT SLEEVE LENGTHS 	<ul style="list-style-type: none"> SEAMLESS CONSTRUCTION SLEEVES ARE MORE COMFORTABLE
LOWER CUFF	<ul style="list-style-type: none"> ELASTICATED TO ALLOW STRETCH AND MOBILITY 	<ul style="list-style-type: none"> SEAMS CAN CAUSE FRICTION & BLISTERS 	<ul style="list-style-type: none"> SEAMLESS CONSTRUCTION MORE COMFORTABLE FINISHES 	<ul style="list-style-type: none"> SEAMLESS CONSTRUCTION IS MORE COMFORTABLE
SLEEVE	<ul style="list-style-type: none"> SOFT COMPRESSION LIGHT, BREATHABLE BARELY THERE FEEL 	<ul style="list-style-type: none"> SOFT COMPRESSION 	<ul style="list-style-type: none"> FIND BALANCE BETWEEN SOFT AND HIGH COMPRESSION GRADUATED COMPRESSION TARGETED ZONES OF COMPRESSION 	<ul style="list-style-type: none"> SLEEVES THAT PROVIDE TARGETED COMPRESSION CAN HAVE GREATER IMPACT ON PERFORMANCE

B

Questionnaire to investigate consumer desire for training aids and performance needs of compression garments, athletic socks, and golf shoes.

SECTION 1 – Intro

Golf Products to Improve Putting Performance

Hello, my name is Jemma Brown. I am currently a second year student in the Sports Product Design Master's Program at the University of Oregon. This survey has been designed to conduct research surrounding the desire for golfing training aids to improve putting performance for my capstone thesis project.

For my thesis project I am investigating the opportunity to develop an innovative line of products (shoes, socks and compression garment) to provide sensory feedback, thus improving positional awareness and training golfers to putt more consistently?

If you have any questions regarding my thesis or would like to chat, don't hesitate to contact me further at jbrown24@uoregon.edu

* Required

1. What is your gender? *

Mark only one oval.

- Male
 Female
 Non Binary
 Prefer not to say
 Other: _____

2. What is your age? *

Mark only one oval.

- 15-19
 20-25
 26-30
 31-36
 prefer not to say
 Other: _____

3. How long have you been playing golf for? *

Mark only one oval.

- 1-2 years
 3-4 years
 5+ years

4. What is your current handicap? (or what was the last handicap you had) *

5. What type of golf courses do you usually play on? *

Mark only one oval.

- Desert
 Links
 Parkland

6. How often do you practice putting? *

Mark only one oval.

- almost every day
 couple of times a week
 couple of times a month
 never
 Other: _____

7. Reading greens accurately can be a tricky task. What techniques do you use to help you figure out the best putting line?

8. What aspects of putting do you struggle with the most? *

Mark only one oval.

- reading the line
- judging pace
- judging distance
- stroke consistency
- mental focus
- Other: _____

9. Do you ever use training aids to help improve your golfing performance? *

Mark only one oval.

- Yes
- No

10. If yes, what training aids do you use?

SECTION 2 – Compression Garments



21. Do you ever wear compression tops when you play? *

Mark only one oval.

- Yes
- No

22. If no, why not?

Mark only one oval.

- too restricting
- too warm
- never seen them before
- don't need them
- Other: _____

23. If yes, why?

Mark only one oval.

- to help with injury
- UV protection
- warmth
- keep cool
- aerodynamics
- better swing feel
- Other: _____

24. Do you ever wear compression sleeves when you play? *

Mark only one oval.

- Yes
- No

25. If no, why not?

Mark only one oval.

- too restricting
- too warm
- never seen them before
- don't need them
- Other: _____

28. If no or maybe, why not?

26. If yes, why?

Mark only one oval.

- to help with injury
- UV protection
- warmth
- keep cool
- aerodynamics
- better swing feel
- Other: _____

27. Would you be interested in wearing compression sleeves that provide sensory feedback to improve positional awareness and thus train you to putt more consistently? *

Mark only one oval.

- Yes
- No
- Maybe

SECTION 3 – Athletic Socks

29. What type of socks do you wear when you play golf? *

Mark only one oval.



Over the Calf



Mid-Calf Crew



Ankle



No Show

30. What brand of socks do you prefer to wear when you play golf? *

Mark only one oval.

- Nike
- Adidas
- Stance
- Under Armour
- Lululemon
- Footjoy
- Other: _____

31. Why did you choose this brand of socks? *

Mark only one oval.

- Price
- Comfort
- Material
- Style
- Other: _____

32. Is there anything you don't like about your current socks? *

33. What features do you value most in socks? (select 3) *

Check all that apply.

- Cushioning
- Breathability
- Aesthetics
- Cut (ankle/mid/high calf)
- Non-slip
- Moisture wicking

Other: _____

34. Would you be interested in wearing a pair of socks that work with a pair of golf shoes to improve foot to ground feel, thus train you to putt more consistently? *

Mark only one oval.

- Yes
 No
 Maybe

35. If no or maybe, why not?

SECTION 4 – Golf Shoes

36. What brand of golf shoes do you wear? *

Mark only one oval.

- Nike
 Adidas
 Under Armour
 Puma
 Footjoy
 ECCO
 G/Fore
 TRUE Linkswear
 Other: _____

37. Why did you choose this brand? *

Mark only one oval.

- Price
 Comfort
 Material
 Style
 Other: _____

38. Is there anything you dislike about your current golf shoes? *

39. What features do you value most in golf shoes? *

Mark only one oval.

- Price
 Aesthetics
 Waterproofing
 Breathability
 Comfort
 Traction
 Tradition
 Other: _____

40. Would you be interested in a pair of golf shoes that increase foot to ground feel to improve positional awareness and hence train you to better understand and immerse yourself in your surroundings on the green? *

Mark only one oval.

- Yes
 No
 Maybe

41. If no or maybe, why not?

3.

Detailed testing plans for collecting performance data on competitor products.

Test Type	Environment	Method	Performance Metrics
Controlled Putting Performance Testing	Ping Putting Green	<p><u>STEP1</u> – Each player will be supplied with a competitor product (either a shoe, sleeve or sock) and asked to carry out the following activity.</p> <p><u>STEP2</u> – Players take 3 putts from specified spot at 3 feet, 6 feet, 9 feet.</p> <p><u>STEP3</u> - Take note of how many putts are sunk and the position from where putts are taken.</p> <p><u>STEP4</u> – Videos of the putting stroke will be taken for every putt.</p> <p><u>STEP5</u> – Players the takes 5 putts from random spots around 12 feet from the hole, making sure to carry out a green reading procedure before each putt.</p> <p><u>STEP6</u> – Take note of line accuracy and the distance the ball finishes from the hole.</p> <p><u>STEP7</u> – Ask player how easy they felt it was to read the green and line up their putt. (scale 1-10)</p> <p><u>STEP8</u> – Each player will carry out previous steps with each competitor product individually and then together (shoe, sleeve and sock) and then without any.</p>	<p>1.Number of putts sunk</p> <p>2.Improvement in swing stroke consistency</p> <p>3.Finish distance of ball from hole</p> <p>4.Effect on golfing performance</p> <p>5.Ease of green reading and lining up putt</p>
Randomized Golf Performance Testing	Driving Range	<p><u>STEP1</u> – Each player will be supplied with one competitor product (either a shoe, sleeve, or sock).</p> <p><u>STEP2</u> – They will be asked to perform 10 random golf shots. (eg, a 100 yard shot to the green flag, then a drive between the red and orange flag etc)</p> <p><u>STEP3</u> – Their performance will be assessed by nothing how successfully they are able to carry out each shot.</p> <p><u>STEP4</u> – They will individually be questioned on how they felt their performance changed and how the product felt during testing.</p>	<p>1.Product ‘feel’</p> <p>2.Effect on golfing performance</p>

<p>Controlled Golf Performance Testing</p> <ul style="list-style-type: none"> -Interview -Observation -Product Comparison 	<p>Kierland Golf Course, Phoenix, AZ.</p>	<p><u>STEP1</u> – Each player will be supplied with one competitor product (either a shoe, sleeve, or sock) and an initial thoughts interview will be carried out individually.</p> <ul style="list-style-type: none"> A Have you ever seen or used this product before? B Have you ever seen or used any similar products before? C Do you like the look of this product? D Is there anything you don't like about this product? E How much would you pay for this product? <p><u>STEP2</u> – Photographs of the player wearing the competitor product will be taken before the round starts.</p> <p><u>STEP3</u> – Round of golf will commence with each player wearing one of the products. They will each be supplied with a notebook to note down anything worth mentioning at the end of the round.</p> <p><u>STEP4</u> – Observational analysis of player interaction with products will be carried out throughout the round. (Notes and photographs will be taken)</p> <p><u>STEP5</u> – At the end of the round each player will be interviewed about their thoughts on the competitor product and their notes will be discussed.</p> <ul style="list-style-type: none"> A How does the product feel against your skin after the round? B Did you feel the product effected your golfing performance? C Did you feel the product affected your putting performance? D What is the best feature of this product? E What is the worst feature of this product? F Would you use this product again? G If yes, why? H If no, why? <p><u>STEP7</u> – Photographs of the player wearing the competitor product will be taken at the end.</p>	<ul style="list-style-type: none"> 1.Product 'feel' 2.Effect on golfing performance 3.Effect on putting performance 4.Product dislikes 5.Product likes
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Winter Term Review Slides

SPD 2022 / Thesis Winter Review

AURA



Golf Footwear & Apparel that heighten senses to immerse players in their environment to improve performance

SPD 2022 / Thesis Winter Review

JEMMA BROWN



AGE : 24

HOME TOWN : St Andrews, Scotland, UK

UNDERGRADUATE DEGREE : MEng Product Design Engineering

SPORTS : Golf, Lacrosse, Skiing

WHY SPD

To combine my knowledge of design and engineering with my passion for sports

FUTURE GOAL :

Secure a job in the United States as a Design Engineer on an Innovation Team

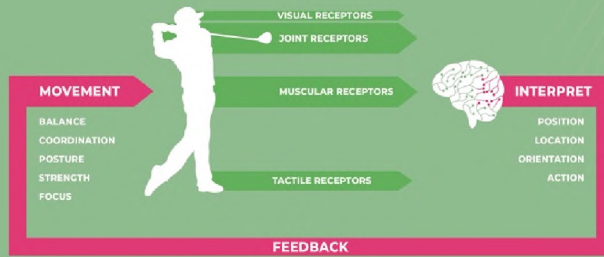
HOW CAN WE..

...design shoes and apparel for male golfers that **work passively** together as a training aid to **heighten proprioception**, and thus **improve putting performance?**



PROPRIOCEPTION IS THE BODY'S ABILITY TO PROVIDE INFORMATION TO THE BRAIN ON ITS POSITION, LOCATION, ORIENTATION AND MOVEMENT OF THE BODY.

PROPRIOCEPTION



PROPRIOCEPTION IN GOLF

6.2
MILLION
NEW PLAYERS TOOK UP GOLF IN 2020.

GOLFERS OF THE 21ST CENTURY ARE
DATA DRIVEN

PROPRIOCEPTIVE PRODUCTS ARE A
SMALL MARKET

- HEIGHTEN**
PROPRIOCEPTIVE EXPERIENCE
- INCREASE**
POSITIONAL AWARENESS
- IMMERSE**
PLAYERS INTO THEIR ENVIRONMENT
- IMPROVE**
PUTTING PERFORMANCE



WHY?



C/FORE
MG4+



TRUE LINKSWEAR
FEEL OG



UNDER ARMOUR
GOLF PERFORMANCE
SOCK



TRU SOX
3.0 THIN



UNDER ARMOUR
HEAT GEAR SLEEVE



FOOTJOY
SUN SLEEVE

BASELINE PRODUCTS



GOLF SHOES

A PAIR OF SHOES DESIGNED TO INCREASE AWARENESS OF THE TERRAIN CONTOURS THROUGH HEIGHTENED PROPRIOCEPTION



COMPRESSION SLEEVES

A PAIR OF SLEEVES DESIGNED TO STABILIZE THE ARMS AND ENCOURAGE BEST GOLFING FORM THROUGH HEIGHTENED PROPRIOCEPTION



SOCKS

A PAIR OF SOCKS DESIGNED TO STABILIZE THE FEET AND WORK IN TANDEM WITH THE SHOES TO FURTHER HEIGHTEN PROPRIOCEPTION

AURA COLLECTION

AURA TECHNOLOGY

A SYSTEM DESIGNED TO IMPROVE A PLAYERS PROPRIOCEPTION THROUGH POINTS OF STRATEGICALLY APPLIED TEXTURE AND PRESSURE.

1. PROVIDE DIRECT TACTILE FEEDBACK
2. IMPROVE AWARENESS

50%

OF PLAYERS FEEL MORE CONFIDENT PUTTING



CLOUD TECHNOLOGY

A BREATHABLE COMFORT SYSTEM DESIGNED TO ENCOURAGE MOBILITY AND PROVIDE CUSHIONING DURING PLAY.

1. PROVIDE BREATHABLE CUSHIONING
2. RELIEVE PRESSURE

10%

PLAYERS FIND IT MORE COMFORTABLE THAN COMPETITOR PRODUCTS



ZEPHYR TECHNOLOGY

A BREATHABLE SUPPORT SYSTEM DESIGNED TO MAINTAIN FOOT STABILITY DURING PLAY IN WARMER CLIMATES.

1. PROVIDE ESSENTIAL LATERAL SUPPORT
2. ENABLE SKIN TO BREATHE

50%

MORE BREATHABLE THAN COMPETITOR PRODUCTS



THE TECHNOLOGIES





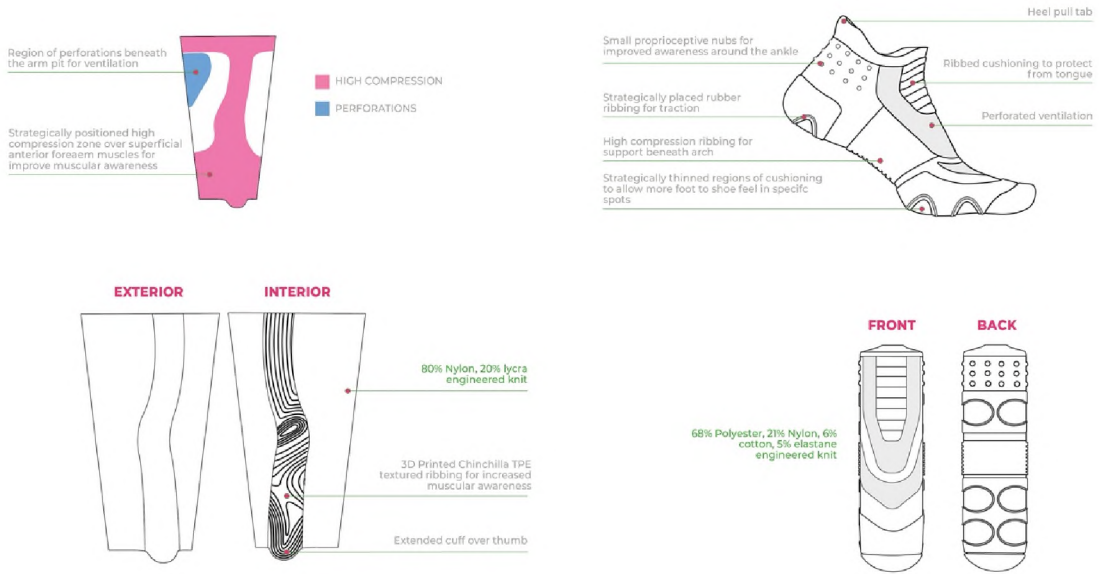
SHOE DESIGN PROCESS



SHOE TECH PACK



SOCK & SLEEVE DESIGN PROCESS



SLEEVE & SOCK TECH FLATS



User was blindfolded and then asked to rate the features of the prototype shoe on a scale of 1 to 10.

AURA SHOE WITH PODS



AURA SHOE WITHOUT PODS



GROUND FEEL SCORE INCREASED WHEN PODS WERE ADDED, BUT COMFORT SCORE WENT DOWN SLIGHTLY.

It was felt the pods did further enhance the experience. They could be felt over the forefoot, but not as much on the heel.



"The pods definitely made a difference, I could really feel them over the forefoot, but the heel was pretty numb"

"I can feel there is a texture on the insole, but I can't tell what the pattern is"

"I feel like you get used to the sensation of the insole and the pods over time, they don't bother me at all"



BLIND RATING TEST



User was blindfolded and then asked to step on a cluster of small objects. The user had to guess how many objects were under their foot.

AURA SHOE WITH PODS

NO. OF OBJECTS	GUESS
9	9
6	5
4	4

G/FORE SHOE

NO. OF OBJECTS	GUESS
7	6
10	8
5	3

USER WAS MORE ACCURATELY ABLE TO DETERMINE THE NUMBER OF OBJECTS BENEATH THE AURA SHOE THAN THE G/FORE SHOE.

The AURA shoe could feel more than the G/FORE, but less than the True linkswear. It also took less time to determine the number of objects when wearing the AURA shoes.

TRUE LINKSWEAR SHOE

NO. OF OBJECTS	GUESS
7	7
5	5
7	7

AURA SHOE WITHOUT PODS

NO. OF OBJECTS	GUESS
5	4
4	3
8	8



"It was so much harder when wearing the G/FORE shoes, I could feel so much more with the AURA shoe"

"I could feel almost everything through the AURA sole, but it still feels so cushioned"

"I can feel even more through the True linkswear shoes"



BLINDFOLDED FEEL TEST

Ultrasonic humidifier was placed on top of the swatch and vapour was allowed to flow down and over the material.

ZEPHYR MATERIAL SWATCH



SYNTHETIC LEATHER MATERIAL



THE AURA ZEPHYR MATERIAL ALLOWS VAPOUR TO PASS THROUGH KNIT BETWEEN 3D PRINTED RIBS.

NO VAPOUR IS ABLE TO TRANSMIT THROUGH THE SYNTHETIC LEATHER SWATCH.



VAPOUR TRANSFER TEST

AESTHETIC DIRECTION

- > Create an cohesive aesthetic across the collection

TECHNOLOGY REFINEMENT

- > Figure out 3D printing onto material metrics
- > Determine optimum shape/size of pods
- > Determine final textures for products

SOCK & SLEEVE TESTING

- > Test sleeve with integrated 3D printed material

MANUFACTURING

- > Try to find a company willing to knit final sleeve and sock prototype

USER FEEDBACK

- > Get feedback on designs from more golfers at both pro and ammeteur level

NEXT STEPS

Spring Term Review Slides






▶ GOLFERS OF THE 21ST CENTURY ARE
DATA DRIVEN

87% OF PLAYERS
▶ BOUGHT A TRAINING AID LAST YEAR

▶ GLOBAL GOLF EQUIPMENT MARKET WORTH
OVER \$7 BILLION


\$6.2 MILLION
▶ NEW PLAYERS TOOK UP GOLF IN 2020


 **WHY GOLF?**

Jemima Brown SPD 2022  02



- ▶ **DETERMINE PACE**
- ▶ **DETERMINE GRADIENT**
- ▶ **DETERMINE LINE**

 **PUTTING**

Jemima Brown SPD 2022  03




- ▶ FLEXIBILITY
- ▶ GOOD POSTURE
- ▶ BALANCE
- ▶ COORDINATION
- ▶ FOCUS
- ▶ PATIENCE

 PUTTING

Jemma Brown SPD 2022 // // 64



▶ THE BODY'S ABILITY TO PROVIDE INFORMATION TO THE BRAIN ON IT'S POSITION, LOCATION, ORIENTATION AND MOVEMENT OF THE BODY

 PROPRIOCEPTION

Jemma Brown SPD 2022 // // 65



 **PROPRIOCEPTION**

Jemma Brown SPD 2022 // 06

- ▶ **HEIGHTEN**
PROPRIOCEPTIVE EXPERIENCE
- ▶ **INCREASE**
POSITIONAL AWARENESS
- ▶ **IMMERSE**
PLAYERS INTO THEIR ENVIRONMENT
- ▶ **IMPROVE**
PERFORMANCE




Jemma Brown SPD 2022 // 07

 **WHY**


TO DEVELOP A COLLECTION OF SHOES AND SLEEVES FOR GOLFERS THAT WORK TOGETHER AS A TRAINING AID TO HEIGHTEN PROPRIOCEPTION BY INCREASING AWARENESS OF THE TERRAIN CONTOURS AND MUSCULAR MOTION OF THE BODY, THUS IMPROVING GOLFING PERFORMANCE

 MY GOAL

Jemma Brown SPD 2022 



 THE ENVIRONMENT

Jemma Brown SPD 2022 



GOLF SHOES

A PAIR OF SHOES DESIGNED TO INCREASE AWARENESS OF THE TERRAIN CONTOURS THROUGH HEIGHTENED PROPRIOCEPTION



COMPRESSION SLEEVES

A PAIR OF SLEEVES DESIGNED TO INCREASE MUSCULAR AWARENESS AND ENCOURAGE BEST GOLFING FORM



SOCKS

A PAIR OF SOCKS DESIGNED TO LOCK IN THE FEET AND FURTHER ENHANCE THE PROPRIOCEPTIVE TECHNOLOGY OF THE SHOES



THE AURA COLLECTION

Jemma Brown SPD 2022

AURA-CEPTION TECHNOLOGY

AN INSOLE SYSTEM DESIGNED TO IMPROVE A PLAYERS PROPRIOCEPTION THROUGH POINTS OF STRATEGICALLY APPLIED PRESSURE.

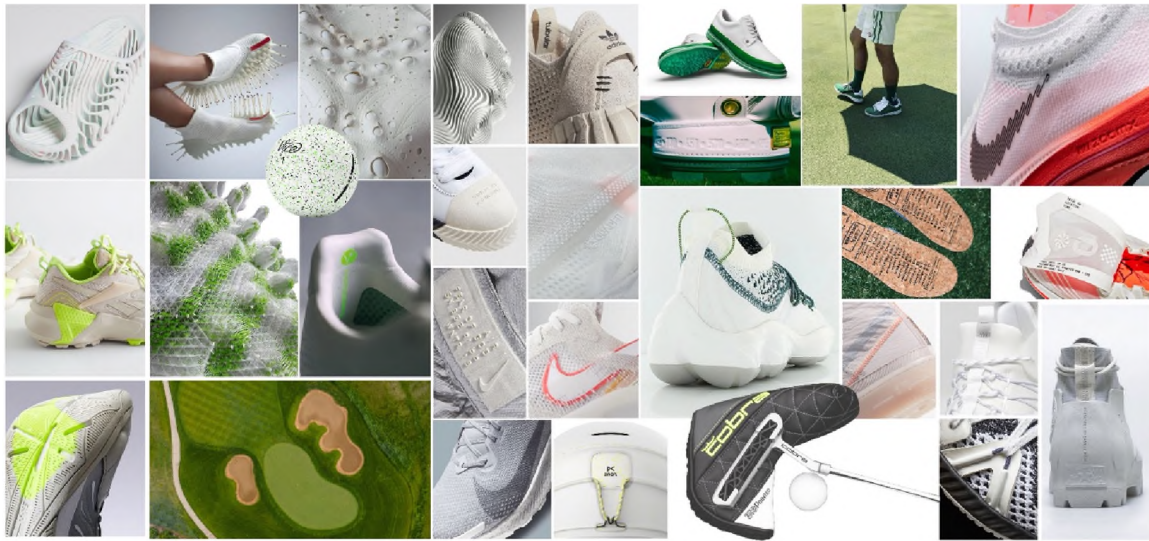
MORPH TECHNOLOGY

A TEXTURIZED STRUCTURE SYSTEM DESIGNED TO PROVIDE BOTH SUPPORT AND SUBTLE TACTILE FEEDBACK TO THE PLAYER.



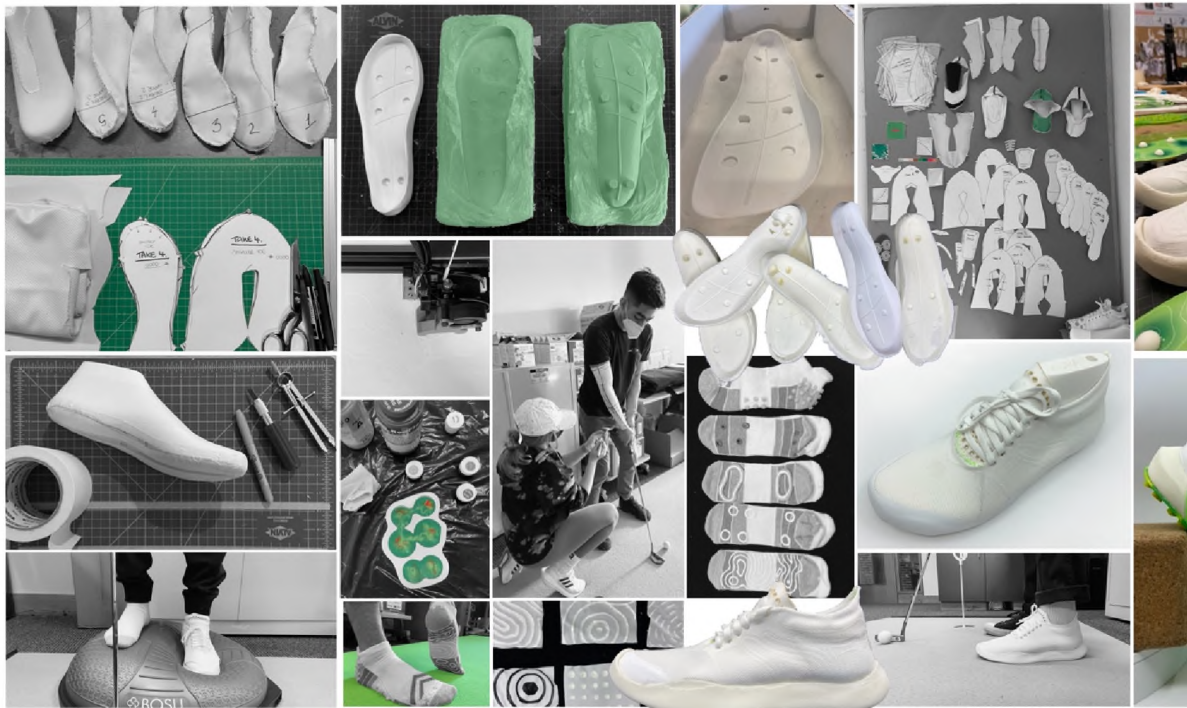
THE TECHNOLOGIES

Jemma Brown SPD 2022



THE DESIGN PROCESS

Jemma Brown SPD 2022



THE DESIGN PROCESS

Jemma Brown SPD 2022

SHOES DESIGNED TO PROVIDE SUBTLE TACTILE STIMULATION TO INCREASE AWARENESS OF THE TERRAIN CONTOURS, AND HENCE IMPROVE PUTTING PERFORMANCE.



THE SHOE

Jemma Brown SPD 2022 // 15

SLEEVES DESIGNED TO PROVIDE SUBTLE TACTILE STIMULATION TO INCREASE MUSCULAR AWARENESS AND ENCOURAGE BEST GOLFING FORM.



THE SLEEVE

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SOCKS DESIGNED TO WORK IN TANDEM WITH THE SHOES TO FURTHER HEIGHTEN THE AURA PROPRIOCEPTION TECHNOLOGY AND INTERLOCK WITH THE INSOLE TO KEEP FEET IN PRIME POSITION.



 THE SOCK

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FINAL PROTOTYPES



Jemma Brown SPD 2022 19



FINAL PROTOTYPES



Jemma Brown SPD 2022 20



 BLINDFOLDED TESTING



Jemma Brown SPD 2022 // 21



“ These are more comfortable than my own nike golf shoes, I would totally buy a product like this ”

I definitely feel more aware of the terrain in these shoes ”


- Player
High level handicap

“ I think this is a great idea. I love the concept of a subtle training aid that doesn't require any technology. ”

I don't think people realise how much you rely on tactile feedback to reinforce habits.

Reinforcing proper golfing form using tactile stimulation has been tried and practiced by instructors with great success for many years. ”

- STEVE NORTH
Director of Instruction at the St Andrews Links

 VALIDATION

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THANK YOU FOR LISTENING



PRODUCT OUTCOMES

- PHYSICAL
 - ▶ PHYSIOLOGICAL IMPROVEMENT IN GOLFING TECHNIQUE
- MENTAL
 - ▶ MENTALLY MORE PRESENT AND FOCUSED
- EMOTIONAL
 - ▶ MORE INVESTED IN IMPROVEMENT

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