

THE GOAL

The goal of this project is to design pointe shoes that offer better ergonomics, aesthetics, and convenience than conventional pointe shoes.

THE PROCEDURE

The project is divided into four main phases:

Phase 1: Understand / Observe

- Understand the anatomy of human feet.
- Observe ballet dancers in action and while choosing, putting on and wearing pointe shoes.
- Interview stakeholders (dancers, teachers, manufacturers, sales people, etc) to find out what they look for in pointe shoes and what they feel the problems with current shoes are.
- Dissect and analyze pointe shoes currently on the market as well as innovative designs and trends in pointe shoes (if they exist).
- Understand current materials and alternative materials with potential for pointe shoe design.

Phase 2: Concept generation

- Sketch pointe shoe concepts that address the problems identified in Phase 1.
- Analyze concepts to determine feasibility and appropriateness
- Select one or more concepts to be developed in the next phase

Phase 3: Concept development (currently underway)

- Develop prototypes of selected concepts. Consider modifying existing pointe shoes.
- Test early prototypes to investigate performance, comfort, and safety (methods will depend on availability of suitably equipped laboratory)

Phase 4: Concept refinement (beyond the scope of this project due to resources required)

- Refine winning concept into final prototype.
- Test prototype with dancers.
- Review prototype design.

In Phase 1, a total of nine ballerinas were interviewed on their preferences, practices, criteria for selecting shoes, and desires in a pointe shoe. These dancers were observed while putting on and wearing their pointe shoes and pictures were taken of them doing so.

One was a retired dancer, currently a teacher who had studied under the direction of George Balanchine at the American Ballet Theatre. Another was a professional dancer at the Jose Mateo Ballet Theatre. Of the remaining ballerinas, five were pre-professional (from either Jose Mateo Ballet Theatre, Boston Ballet, or Lexington School of Ballet) and two were part of the Young Dancer's Program at the Jose Mateo Ballet Theatre.

Additionally to these interviews, e-mail surveys were sent out to various ballerinas around the country. Twenty responses were received and these gave valuable insights into what ballerinas look for in their pointe shoes and how they feel about their shoes.

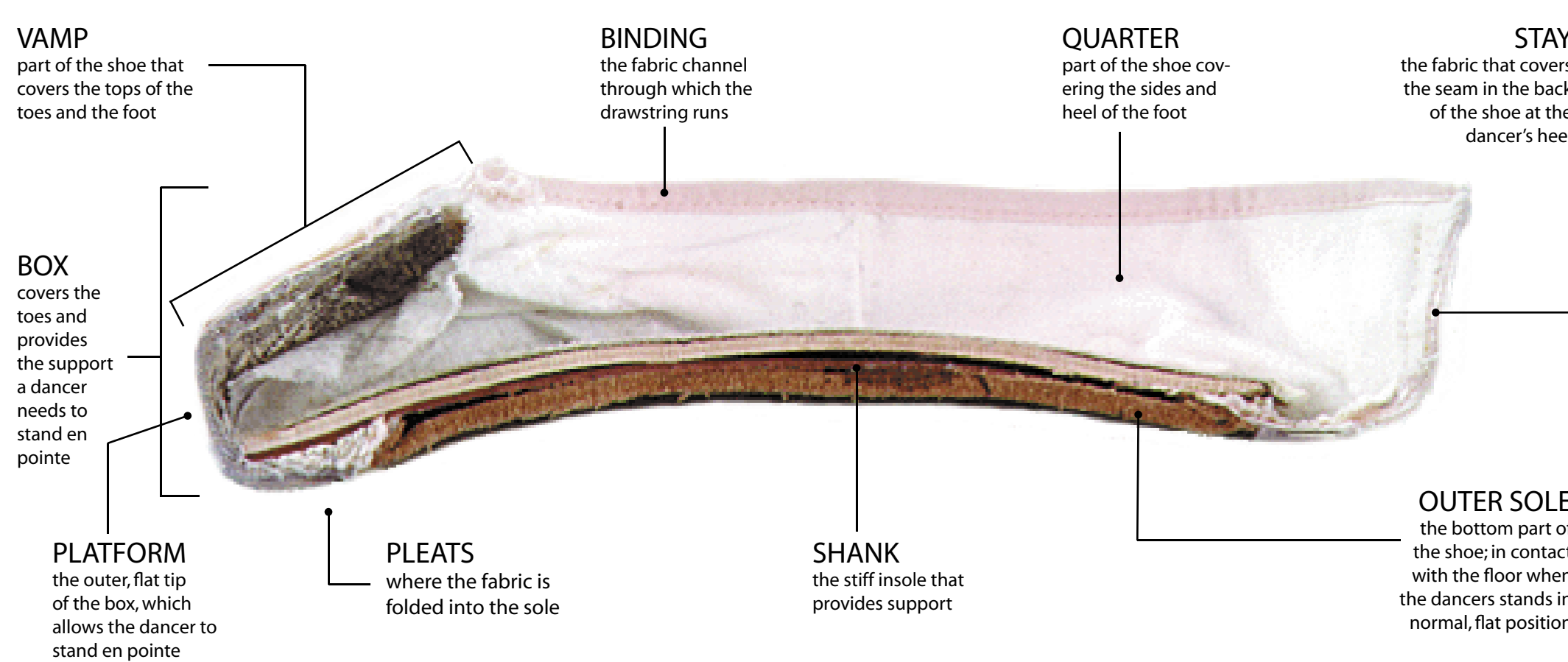
THE CURRENT POINTÉ SHOE

In the early 1800s, Marie Taglioni broke all previous barriers of ballet by being the first ballerina to dance on her toes. To dancing not only **expanded the horizon of possibilities for ballet**, but over time, it became in itself, an artistic expression.

The *old pointe shoe* was made of layers of **burlap** and **paper** saturated with **glue**. The shank was made from **cardboard** for fiberboard and all that held the shoe together was glue, stitching, and small nails.

What then, you may ask, constitutes the *modern pointe shoe*? The truth is the **pointe shoe has not changed at all from the 1800s**. Not only are their materials rudimentary and primeval but also their designs offer no protection to the feet and ankles. In fact, the majority of ballerinas suffer from foot ailments and other injuries that will inevitably follow them for the rest of their lives.

Since the 1800s, costumes, stage sets, theatres, and lighting have all been revolutionized. Yet the pointe shoe remains unchanged. A **ballerina's shoe is an extension of her body and is intimately related to her dancing**. Today, as ballerinas demand increasingly more from their shoes, I feel it is time for these primitive objects to change.



SUMMARY OF RESEARCH

Age	Total	Number of years on pointe	Total	How do you prepare your shoe?	Total	Injuries	Total
less than 10	0	less than 1 year	0	sew ribbons	19	Shin splints	8
10-13	2	1-3 years	6	sew elastics	16	Ingrown toenails	13
13-17	16	3-6 years	14	sew elastic loop on back of shoe	4	Fungus nails	4
17-20	3	6-10 years	2	apply nail polish to ribbons	3	Bruised Toenails	10
20-25	3	10-15 years	1	burn ribbons	12	Blisters	25
25-30	1	15+ years	2	cut off satin from platform	5	Warts	1
30-35	0			apply nail polish to platform	1	Corns	6
35-40	0			burn satin of platform	1	Hammer toe/Claw toes	2
40+	1			take out nails	3	Morton's toe	4
				wet the shoe	7	Metatarsal pain	4
				shave off some of the shank	1	Bunions	12
				hammer the shoe	1	Arch pain	14
				hit shoe against floor	12	Heel pain	9
				bend shoe to create nicer arch	15	Tendonitis (across top of foot)	4
						Tendonitis (Achilles tendon)	12
						Ankle sprain	4
						Dislocation	3
						Broken bone	0
						Fracture	1



PHASE 1

"The Ballet toe shoe is one of the few instruments of torture to survive intact into our time"
Anonymous

GETTING TO THE Pointe

Development of innovative pointe shoes
Lina A. Colucci



The Quarter:
Covers the heel and the sides of the foot

- Holds the shoe snug against a dancer's foot
- Never does its job properly

Replaced with a single elastic quarter that rises up slightly higher than normal to form a type of boot

- molds to any foot
- keeps shank tight against the foot



Pointe Shoe Selection Criteria:
Top 12 Characteristics in Order of Preference Based on Dancer Questionnaire

- Fit
- Comfort
- Box/platform shape
- Vamp shape
- Durability
- Shank Style
- Breaks in quickly
- Heel depth
- Price
- Availability
- Drawstring location
- Color

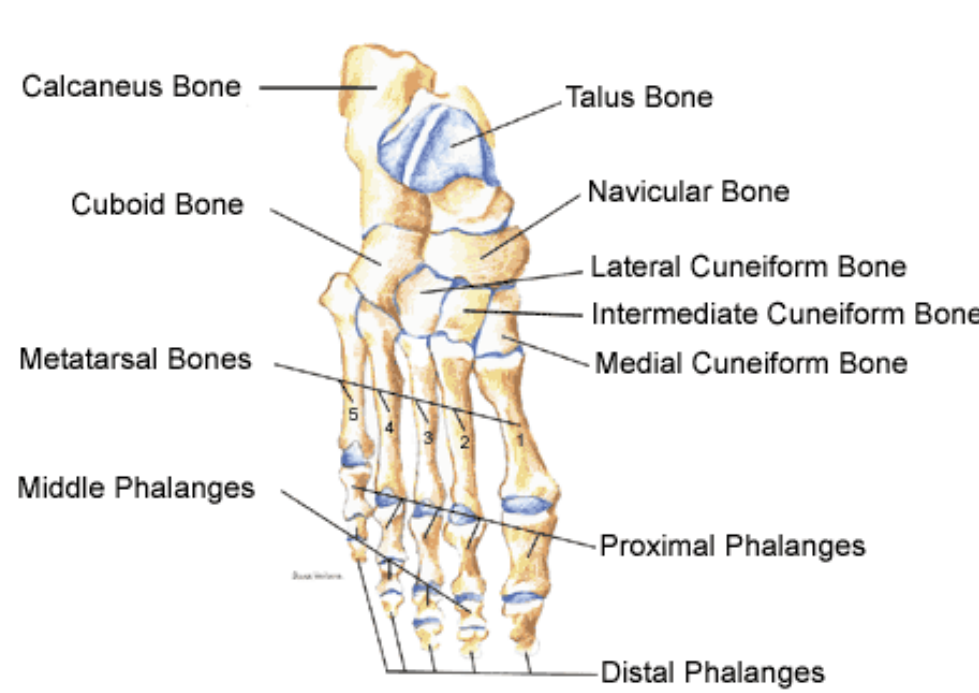
Tying ribbons too tightly leads to long term problems such as Achilles tendonitis.



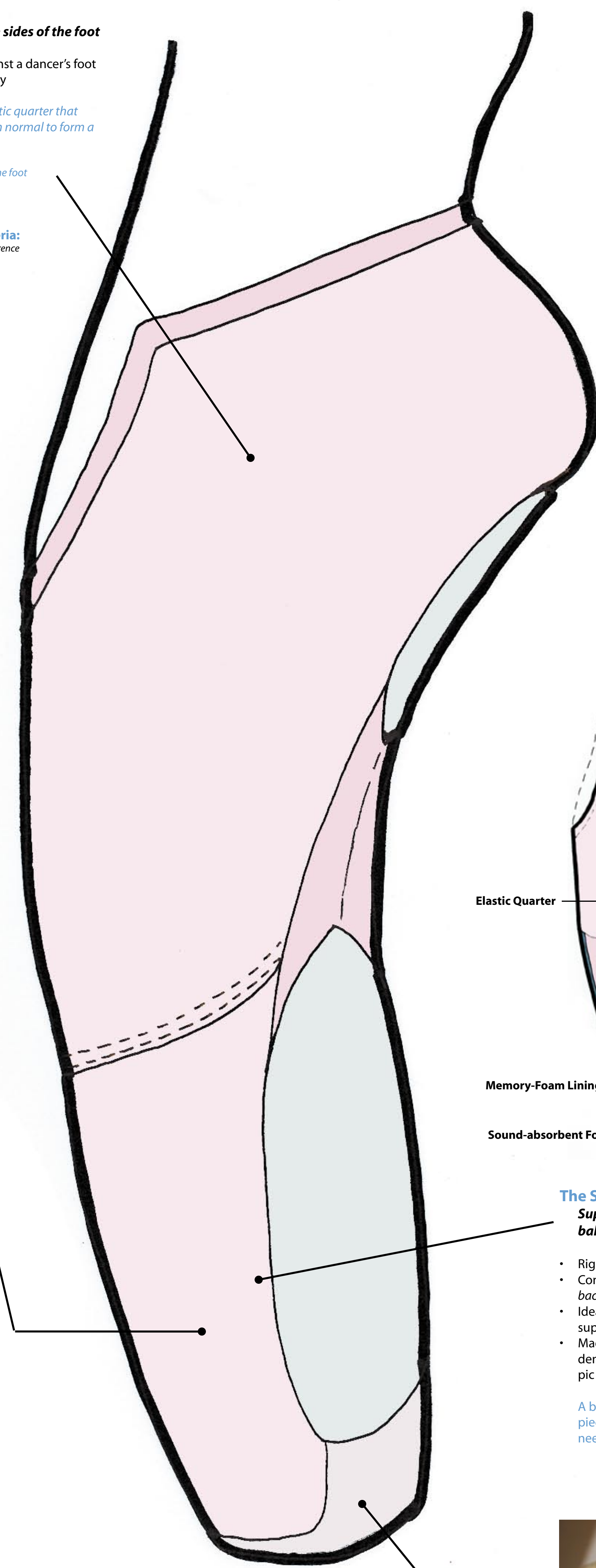
The Box:
Part of the shoe encasing a ballerina's toes

- Improper fit is the cause of many injuries
- Fit of the box is way a ballerina determines comfort of the shoe
Has memory foam lining in the interior
 - promotes comfort
 - personalized fit
 - distributes weight of body between all toes
- Must remain stiff throughout life of shoe
Made of non-degenerative materials
- Loudness of box on floor
Thin layer of sound & shock absorbent foam between carbon fiber box structure and satin covering

Top View of Foot Bones

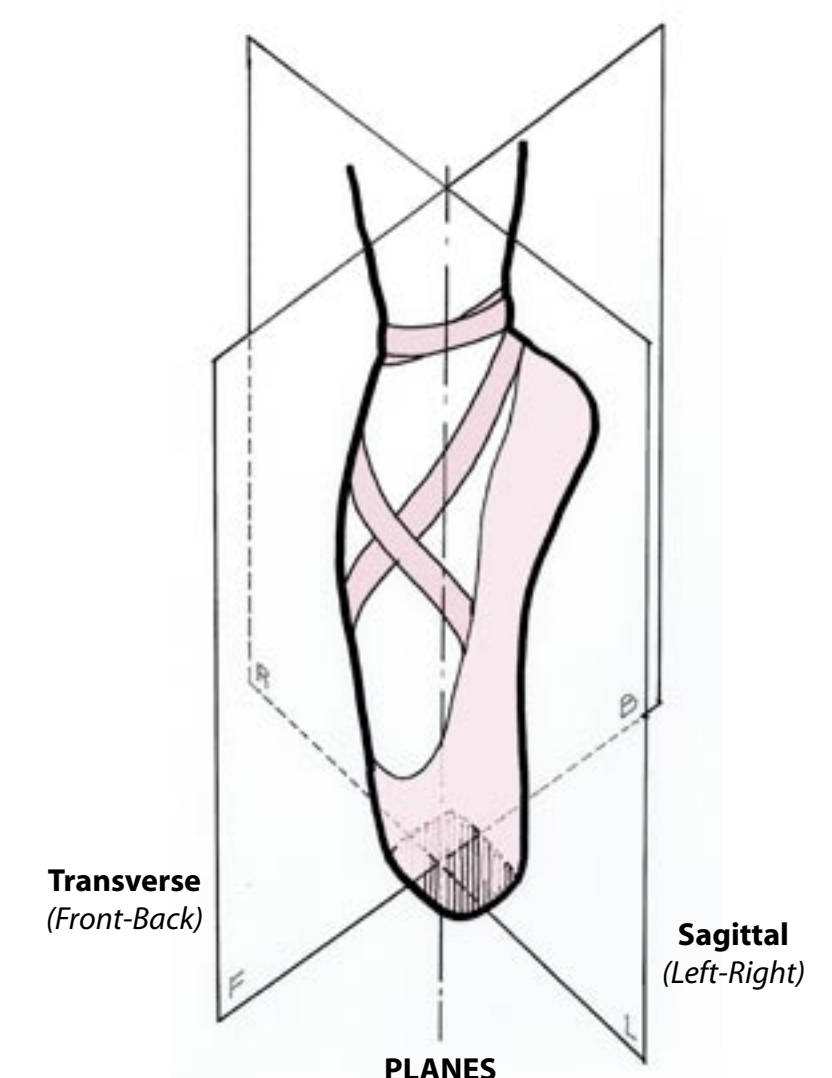


Improper fit of the box is the main cause of nail valgus. In conventional pointe shoes, the entire weight of the ballerina is on her ballus.

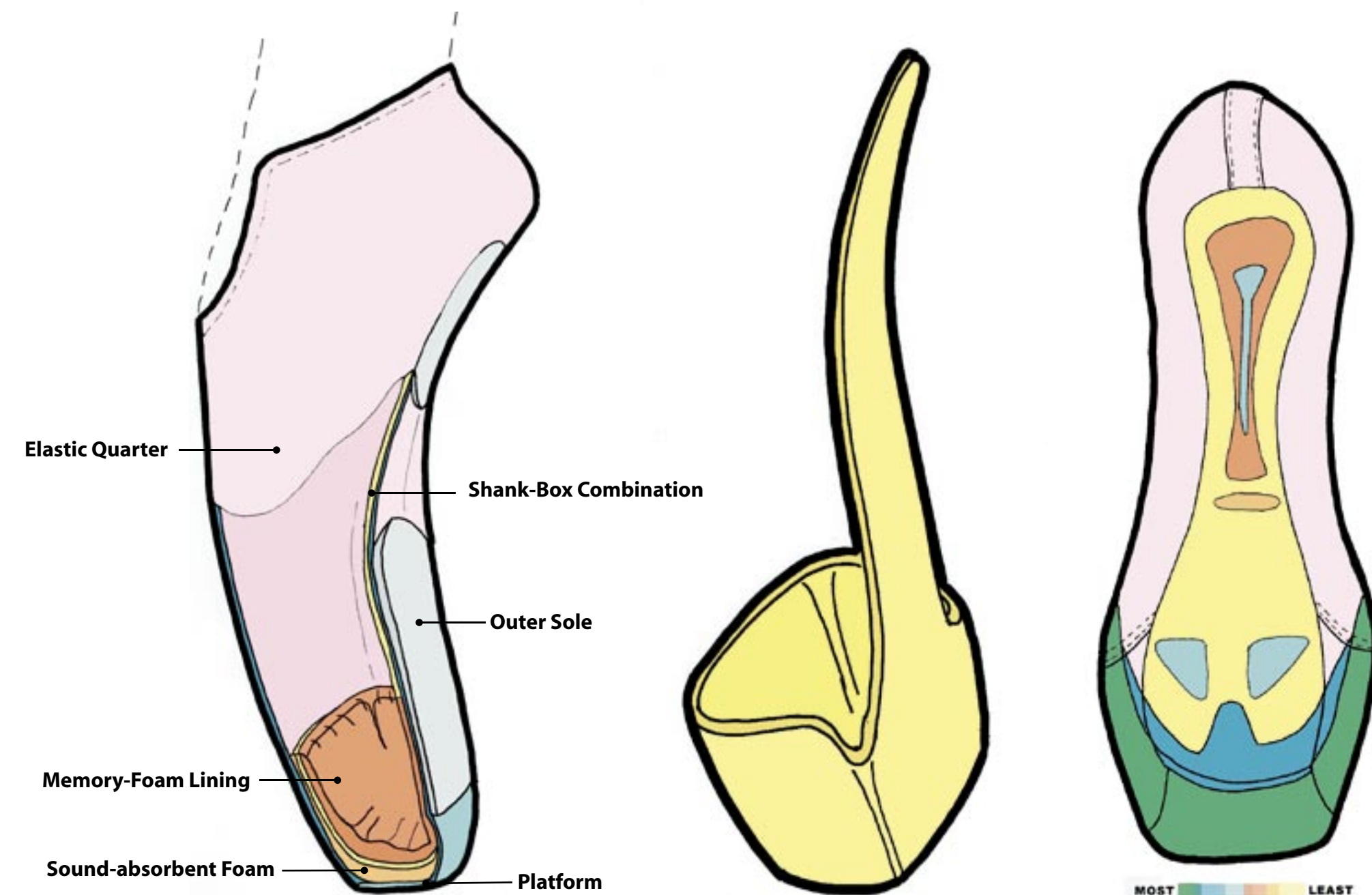


It is necessary for the shoe to be rigid along the **sagittal plane** (left-right) since any movement in this direction is usually detrimental to a dancer's technique. Excessive flexibility in this direction leads to the formation of bunions and it promotes ankle sprains and/or fractures.

Along the **transverse plane** (front-back) however, it is necessary that the shoe offer controlled flexibility to allow ballerinas to transition smoothly between the flat and pointed position. The only area in this plane that needs inflexible support in the part of the shank directly under the toes. The stiffness in this area allows a dancer to balance indefinitely on the tips of her toes. The remaining areas from metatarsal to heel require great flexibility because it is from these areas that a dancer achieves the full pointedness and curve in her foot. Conventional pointe shoes have excessive support in these areas and this ends up being counter-productive to a dancer.



Where isn't the shoe bending?



The Shank and Box:
Supportive structures that allow a dancer to balance on the tips of her toes

- Rigid along the **sagittal plane** (left-right)
- Controlled flexibility along **transverse plane** (front-back)
- Idea is to create a shank designed to offer differential support on critical areas of the foot
- Made of materials whose stiffness can be independently controlled along the various planes (anisotropic properties)

A base layer of carbon fiber with additional pieces of carbon fiber over the areas that need additional support



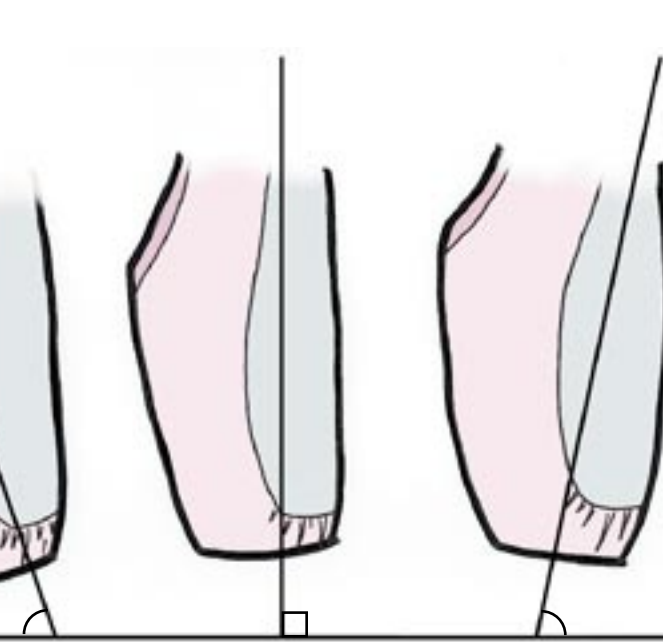
The Platform:
The flat area on the tip of the shoe where a dancer balances when en pointe

- The area receiving the most wear – constantly in contact with the floor
- Needs right amount of adherence to the floor
Tyvek: combination of strength & slide with ease
- Inclusion of platform relative to the shank
Most favorable: intermediary between being inclined towards the shank and being at a 90 degree angle to the shank

The Sole:
Part of shoe in direct contact with the floor when in a flat position

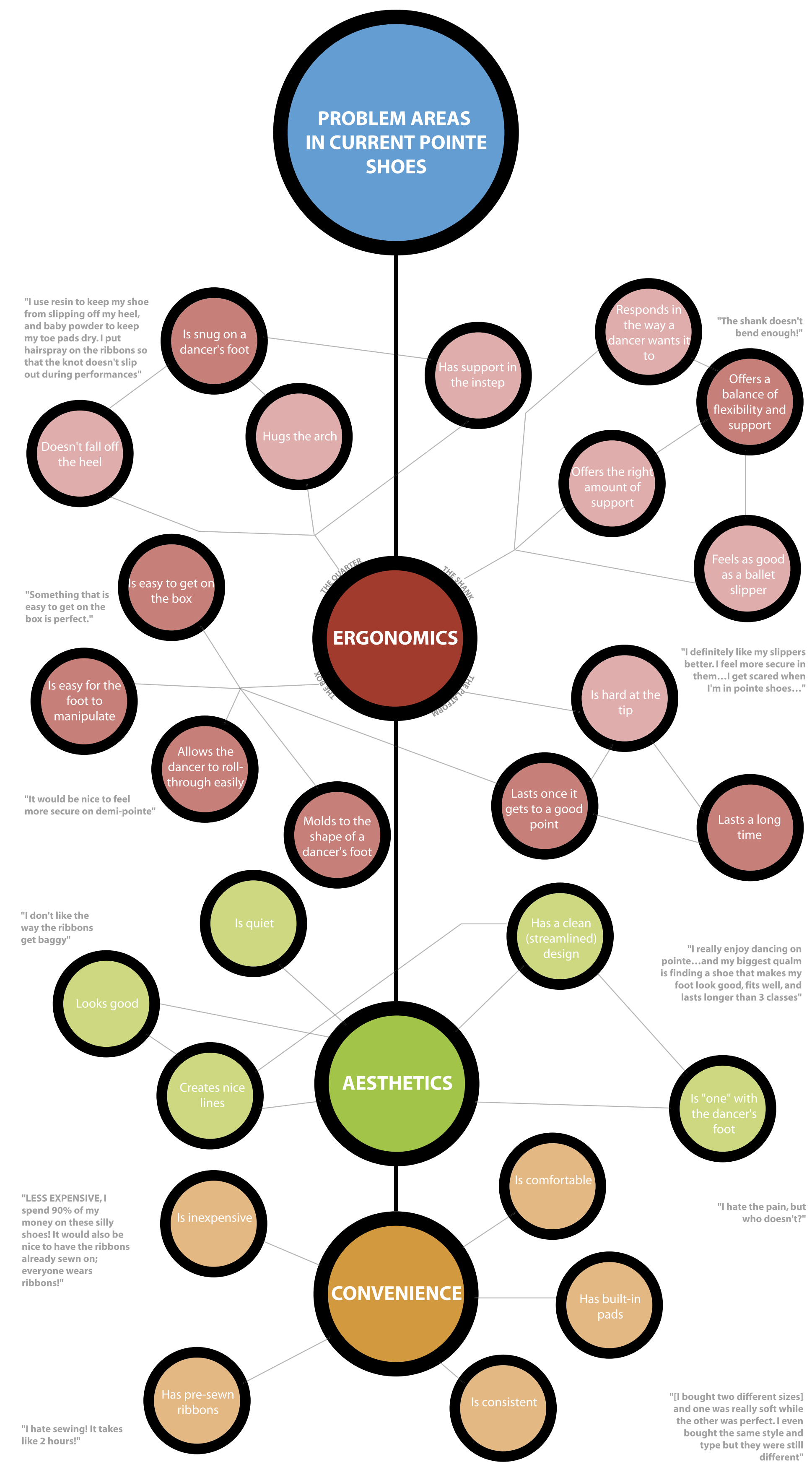
- No supportive roles
- Prevents slipping on the floor
- Must withstand wear
- No major problems associated with conventional sole

Make a thin split-sole leather shank

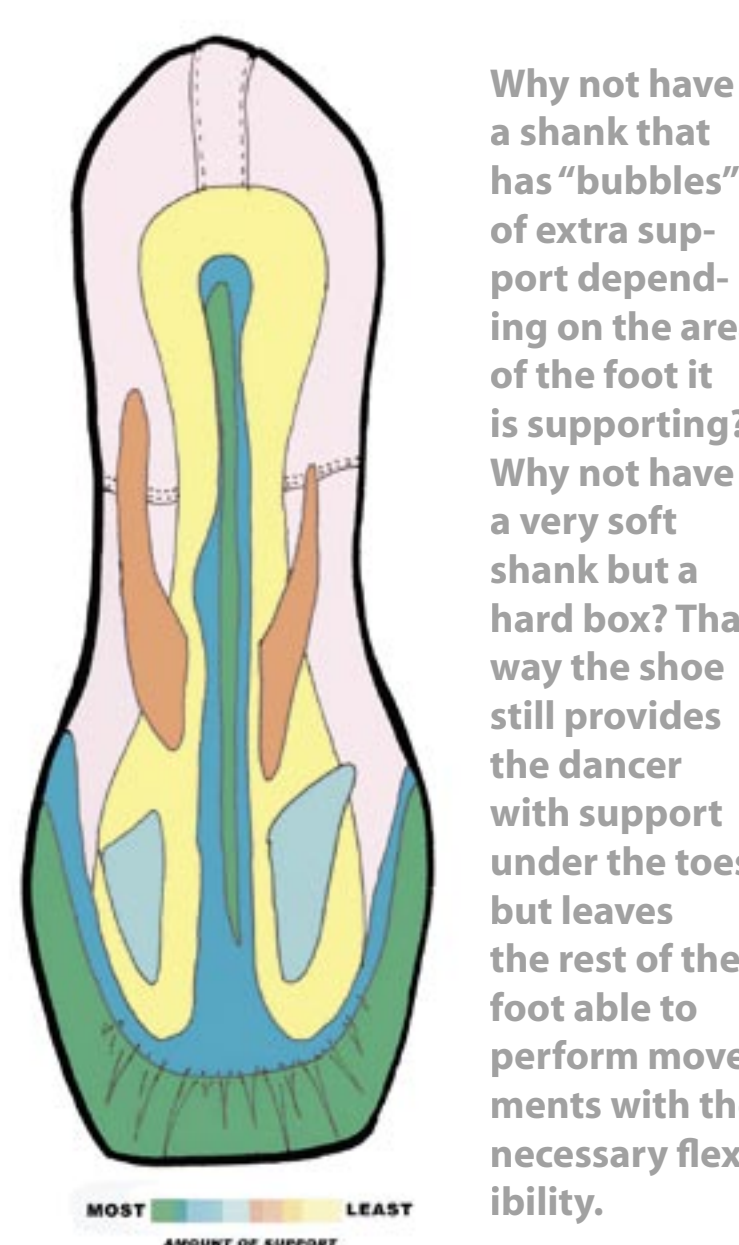


ACKNOWLEDGMENTS

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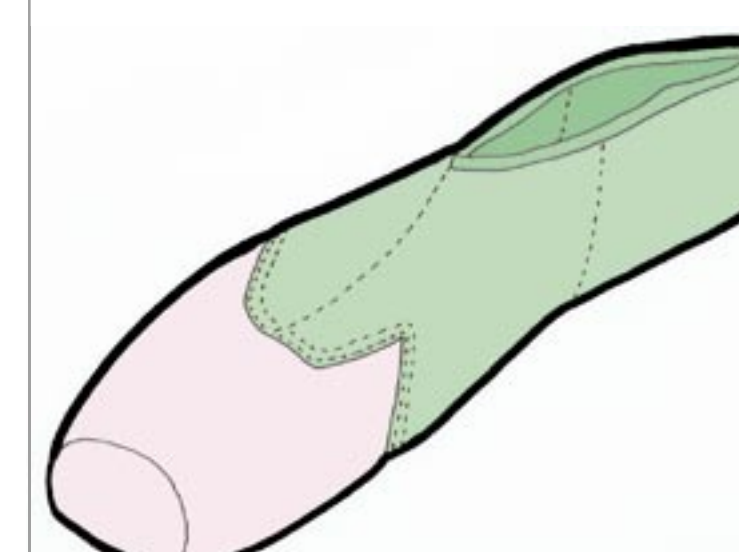


"Support Bubbles"



Why not have a shank that has "bubbles" of extra support depending on the area of the foot it is supporting? Why not have a very soft shank but a hard box? That way the shoe still provides the dancer with support under the toes but leaves the rest of the foot able to perform movements with the necessary flexibility.

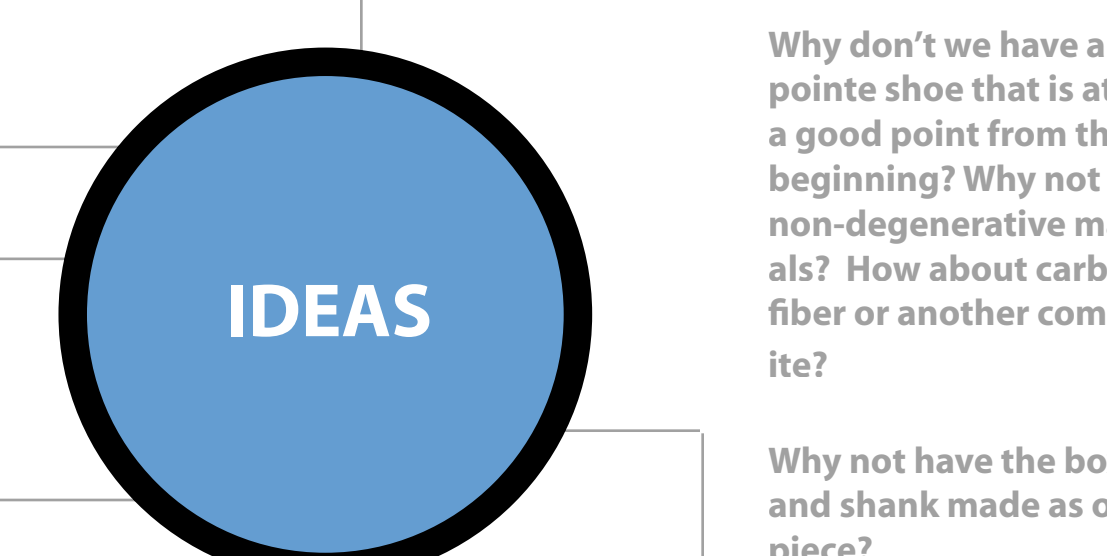
"Booty Shoe"



Why not have the entire shoe's quarter made of an elastic material? This way the shoe would never fall off the foot and would be able to accommodate a wide variety of feet

Why not have the shoe's quarter rise up higher - to form a type of "boot"? This removes the need for sewing by removing ribbons and elastics from the shoe.

"Right off the Shelf"

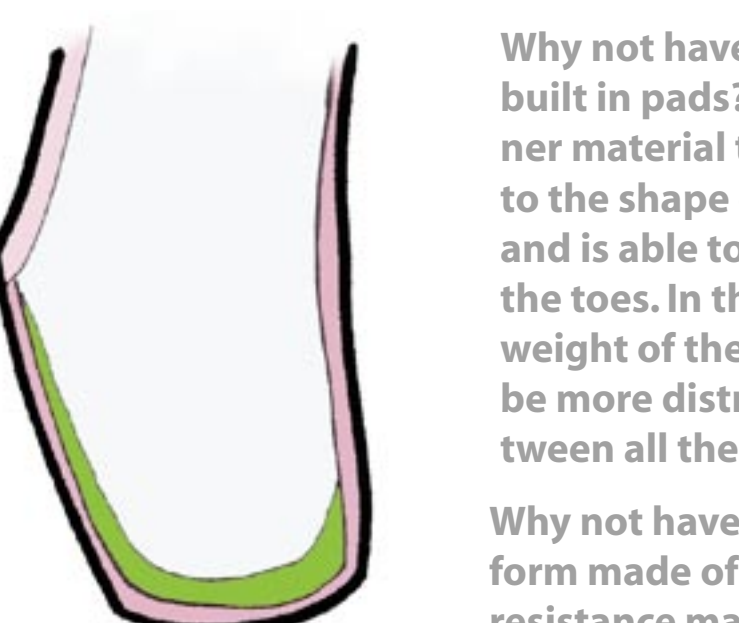


Why not have a pointe shoe that is at a good point from the beginning? Why not use non-degenerative materials? How about carbon fiber or another composite?

Why not have the box and shank made as one piece?

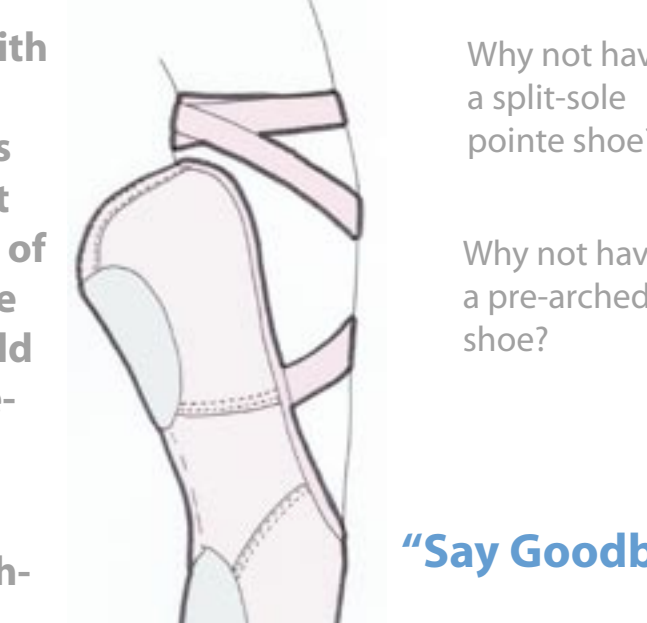
IDEAS

"All-Day Comfort"



Why not have a shoe with built-in pads? Some inner material that molds to the shape of the foot and is able to cradle all of the toes. In this way, the weight of the foot would be more distributed between all the toes.

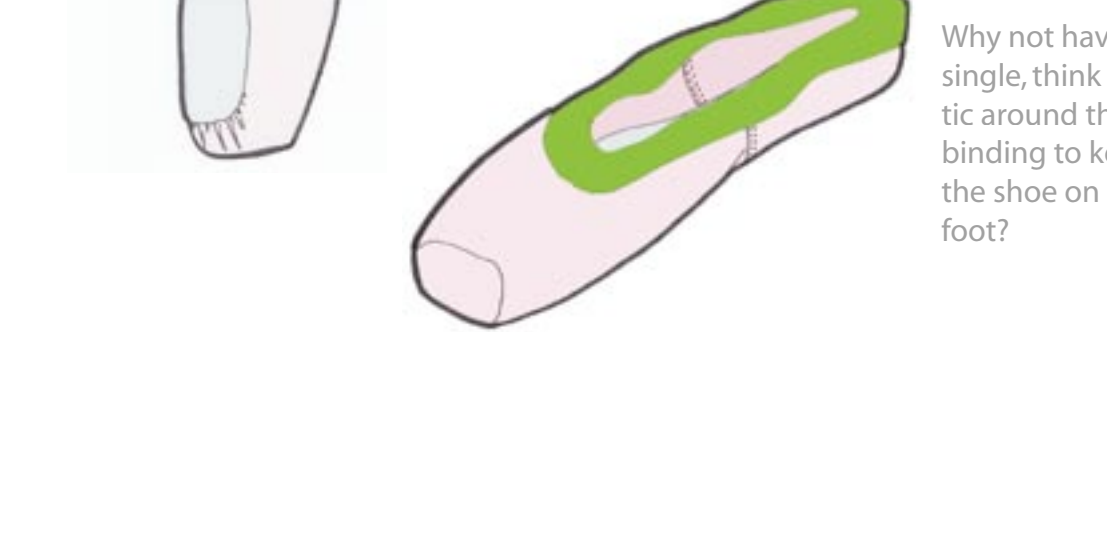
"Instant-Pointe!"



Why not have a split-sole pointe shoe?

Why not have a pre-arched shoe?

"Say Goodbye to Ribbons"



Why not have a single, thick elastic around the binding to keep the shoe on the foot?

PHASE 3

PHASE 2