

The *Simple-Basic* Backpack

by Matthew Grandin 4/20/11

In my mind the art of good product design is to be passionate about helping people while designing products with superior performance and distinct cultural value. My challenge is to design and create an everyday carry (EDC) backpack that gives users the confidence to do everything they want anywhere without worrying about their belongings or comfort. As foreshadowed in a blog post titled Backpack Shapes & Functions, “A new category is still to come that merges and severs the functions needed between work and play” (Carryology, 2011). Furthermore, it seems specific outdoor recreations have functional and tactical backpack products while urban backpacks are low quality, bland and featureless. A bag that “does everything” needs to be well rounded. I designed a backpack that best serves the urban dweller’s carrying needs. It consists of a modular harness, padding and cargo storage components which are custom-assembled by the customer to increase user efficiency and emotional attachment. It is a system with varying levels of ergonomics, load-bearing capabilities, electronics protection, capacity and weight which, can accommodate people who need a rugged and weatherproof pack to haul a day’s worth of gear but who also need their bags to have enough sensitivity to cradle fragile electronics and organize small objects. Versatile yet inclusive of specific features that facilitate needs, like hydration, spur-of-the-moment picnics or rainstorms. It always needs to be the perfect size (which amounts to only the size of the things inside). It must be padded when you need padding but not bulky when you don’t. It’s got to be comfortable for everyday loads but with safety factor built in for unexpectedly long walk or heavy load. Therefore a proper ergonomic harness is an important incorporation to the final design. Its got to look cool, but professional enough for the office. To do everything everywhere a bag needs to be sensitive to a variety of environments — wet, formal, clean, abrasive, dirty, muggy, unsecured, etc.

As a product designer forced with the task of choosing my own product to design I was drawn to the broad idea of universal utilitarian objects. I decided to design carry products for my capstone senior project at the School of Art & Design. Their close proximity to human existence, the task of carrying stuff is as fundamental as gravity. I believe the product category has lifetime potential for functional, cultural and institutional innovation. To understand what it takes to make the best bag for an urban dweller’s multiplicity of needs, I followed a variety of paths of research. I will first offer a history of carrying devices and ergonomics, going into detail on the military’s load carrying and organizational

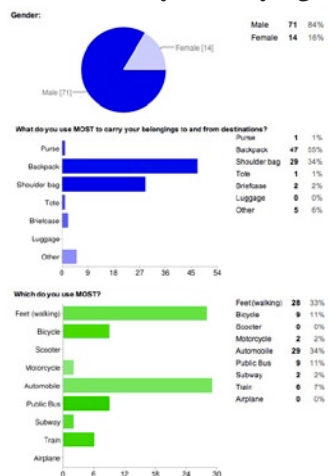


Fig. 1 - HDYC survey results.

derivations. I will focus on the dilemma of an urban dweller’s specific carrying needs and how the backpack I created addresses those needs. Finally I will explore the market and health issues associated with current bag and backpack trends.

I collected and organized online inspirations at my project blog, Bag Blog (mattgrandin.tumblr.com) where I made 89 posts (as of 4/19/11) on a variety of subjects including newly released backpack models, innovative concepts, materials and construction technology. I gathered external perspectives and experiences from a survey I distributed to 84 people, readers of Bag Blog and another carry-interest blog called Carryology. The responses of these lead users makes my targeted backpack survey especially insightful. I will reference the results of the “How Do You Carry?” survey (Fig. 1) throughout this paper, referring to the survey as HYDC for brevity’s sake.

Evolution of the Modern Backpack

Since the possession of multiple belongings is a trait unique to humans, and carry tools are as old as humanity itself, I believe backpacks have undergone long term mechanical evolution. “Mechanical Evolution is the tendency...to apply the idea of biological evolution to mechanical devices, wherein later versions of the devices become progressively more suited to their niche (or more likely just progressively better at everything)” (Tvtropes.org). “The Native Americans used backpacks, sometimes configured as a woven basket with shoulder straps, sometimes as a flat backboard to which gear could be lashed.” (Bob Shaver, 2005) This concept was modernized by early settlers of the United States. “Before the 1920’s the usual pack was a limp canvas sack equipped with shoulder straps. Only careful packing prevented the contents from digging into the hiker’s back. The weight of the pack sagged down on the hips. The heavier the load, the more the carrier bent forward. Lloyd F. Nelson is the man who developed and patented the rigid type of pack board which carries his surname. To him belongs the credit of eliminating discomfort, and adding pleasure, to backpacking. The pack board designed by Nelson has a sturdy wood frame which distributes the weight and supports the bulk of the load on the shoulders. A canvas jacket cushions and ventilates the back. A “tailor-made” canvas bag, which can be attached or removed in a jiffy, further facilitates the art of packing” (Widrig, 2004).



Fig. 2- Opsrey packs Airspeed back panel ventilation technology.

It is not surprising that many of the highest quality backpacks have been designed for use in nature. After all nature predates cities, suburbs, car culture, mass transit and all other modern factors that influence the way we carry. Hiking and mountaineering packs have the most evolved suspension and harness systems available on the market. Today’s external framed packs are made with lightweight aluminum and ripstop nylon. They have complex ventilated back panels (Fig. 2) and water tight welded seams.

Current backpack harness design has more to do with the hips than the back and shoulders. “Weight is transferred to the hips using a padded belt connected to the lower part of the backpack and secured around the user’s waist. Shoulder straps, far from being a way to ‘hang’ the pack on yourself, simply keep the pack from twisting or rotating.” (Ergonomics and Backpack Vacs) In the past 30 years the diversity of backpack products has increased astoundingly. The outdoor industry and military are the two largest backpack industry innovators in terms of the concept of mechanical evolution and have often worked in tandem (Gordon Lubold, 2003). They have developed a great number of lightweight textiles and technologies while maintaining a high level of durability. Given the emphasis



Fig. 3 - Early military style packboard likely from the 40s. Found on www.usmilitariaforum.com under the thread Canvas & frame packboard. Posted by Administrator.



Fig. 4 - MOLLE (Modular Lightweight Load-Carrying Equipment) used by current US Military personnel.

on safety, the military has developed rigorous standards for the materials and construction methods they allow. The military's rich history of systematizing operations had developed many useful innovations in the transport of persons and their gear. Specifically the actions and interactions of their personnel with the gear and tools they use. Products like the reconfigurable MOLLE system for tactical vests, field packs and attached cases enables soldiers to perform complex tasks with maximum speed and efficiency (Fig. 4). They can configure their personal

body armor, weaponry, combat accessories and safety items for maximum effectiveness based on the unique requirements and conditions of each mission. World militaries have been using modular gear for hundreds of years now, the first such item was a belt-mounted sheath for blades. Fighters could slide a sheath onto their belt if they anticipated a fight or could remove it in times of safety. While the outdoor industry and military are the two largest innovators, the recreation, fashion, and professional industries have diversified the offerings further. Today's recreation industry delivers a wide variety of specific-activity backpacks, ranging from rock climbing to roller blading. The recent trend of bags made for bicycle couriers piqued my functional interest due to their single cavernous pocket for carrying bulky objects and their high durability. Local and custom messenger bag operations seem to be increasing partially due to the relative simplicity of messenger bag construction along with the desire and ability to create culturally unique products. I was also inspired by companies that add additional services and values to the equation in addition to the expected benefit of carrying stuff. Some companies use recycled materials in their products (Fig. 13) while others allow customers to customize the looks or features of custom made backpacks.

Design Research

The bag's use environment has a lot of bearing on the design of packs. Each separate context requires specific design considerations — for example pickpockets rarely exist in the same environment as wild animals. A large portion of hiking pack use occurs on the trail as passive carrying. The gear inside the pack is typically durable so few considerations are made for protecting pack contents. Modern urban environments are very different from the great outdoors. Currently most people live in some form of urban environment (Fig. 5), yet well-rounded packs optimized for the unique diversities of urban environments only represent a slim minority of available products. Typical urban environments include abrasive asphalt, sharp corners, tall buildings, infrastructure like grocery stores, ATMs, shopping malls, mass transit, cars, bicycles, security hazards and weather. Throw fragile electronics, fresh produce and other sensitive possessions into the mix and you realize how complex the modern carry scenario really is.

With extensive personal and observational experience schlepping stuff I started to evaluate which problems needed the most addressing. I defined two distinct operational criteria of carry products: **active interaction**, dealing with the accessibility of belongings, packing and organization, and **passive carrying**, dealing with in-transit interactions and

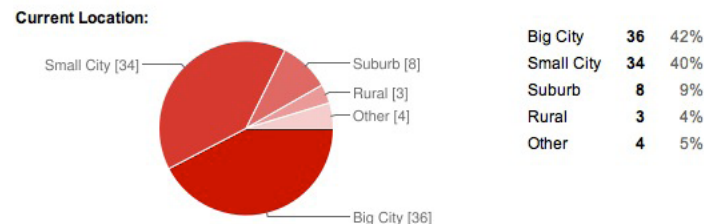


Fig. 5 - Location of 85 survey respondents from the online How Do You Carry? survey. Grandin, 2011.

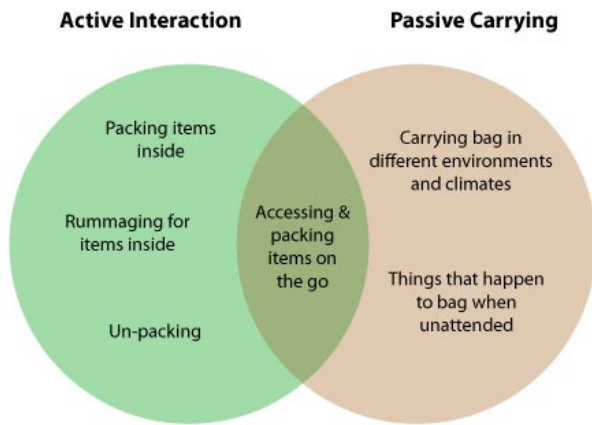


Fig. 6 - Active interaction vs. passive carrying diagram. Grandin, 2011.

Today's users expect their bag to deliver the same level of comfort whether they are carrying a heavy load or an average one. "When weighed down only by my laptop and a couple of books, it doesn't distribute the weight well at all." Users want more comfort, however they don't want to be hindered by added functional necessities. "The straps for waist hang down a lot if I don't buckle them, resulting in damaged buckles so I can't use them even if I wanted to" (HYDC Survey, 2011)

Aspects of **active interaction** tend to pose more usage and organizational problems. For example some, including myself find, "Carrying small objects — wallet, cellphone, passport— with easy access (but still protected enough from pickpockets)" consistently problematic. Users address problematic interactions with their current bags, "When I pull them out of my bag they pull everything out with them. I am constantly checking to see if anything has dropped to the ground" some just cut to the point, "Crap organizing." (HYDC Survey, 2011) The majority of survey respondents agreed that their bags should protect fragile objects from impact and crushing, however they admit that their current bags do not. I have personal experience carrying sensitive electronics in inhospitable places and it can be nerve racking. Carryology points out some of the ironies of this topic in their post titled *\$5000 of tech in a \$40 backpack?*, "do you ever stop and think > 'My god, I have over \$5k worth of equipment in this bag right now and I'm trusting a \$40 backpack to protect it all!'" This quote is a testament to the fragility and fallibility of modern techno gadgets. However some objects like, glasses, food containers, produce and beverages are unlikely to become more sturdy over time and still need to be provided for in a long term design solution. Other objects noted as "problematic to carry" through HDYC were shoes, tools, lots of small items, coins, wet umbrellas, bulky items, cables, nice clothing, pens and pencils, coffee and loose papers. My survey proved very useful in recognizing the extent of problems created just by the stuff inside the bag but users' possessions are only one part of the equation.

Additional Responses From "How Do You Carry?"

"I sometimes find that when I have a lot of space to fill, I will even when it's not totally necessary."

"I'm conflicted when deciding to carry my checkbook and passport. I live in Paris. I need them occasionally but I hate the thought of losing them."

"Planning a short work trip and deciding if I'll need my laptop. It's really heavy, so it's a big commitment to haul it when walking significant distances."

load-bearing qualities. A casual way to differentiate this distinction is the difference between the sack portion and harness portion of a backpack, which serve very different purposes.

I think that the **passive carry** experience is the most important for a utilitarian urban bag because it is directly related to comfort. This passive aspect of carrying usually poses ergonomic and engineering problems. One backpack user notes of his backpack that "The back needs some reinforcement; it's too floppy. I use a hard backed note pad." (How Do you Carry? (HYDC) Survey). This user is using a retro styled pack with less support than Trapper Nelson's Packboard.

Product Criteria and Goals

The plan was to design a backpack consisting of modular harness, padding, and cargo storage components which is custom assembled by the customer to increase user efficiency and emotional attachment (Fig. 7). A system with varying levels of ergonomics, load bearing capability, electronics protection, capacity and weight which can accommodate people who need a rugged and weatherproof pack to haul a days worth of gear but that also has enough sensitivity to cradle fragile electronics and organize small objects.

I wanted to create a durable product intended to last an everyday user a lifetime or more. This backpack needed to be waterproof because I rely on it to protect my sensitive electronics in a variety of environments and climates. It needed to be padded to protect electronics and other fragile items from shocks. I was very interested in including an expandability feature to allow the addition of a couple more items once the bag is already full. The load needed to be carried securely

without shifting and needed to have multiple pockets with different levels of security and access. The ultimate goal is to design a backpack system that is profitable and marketable because it delivers benefits through consumer education. The last criteria was that I design a fully functional prototype product that I could make myself and use seriously.



Fig. 8 - Backpack prototype #1 loaded. Grandin 2011.

pocket allows for bulky items and is lined with a durable waterproof vinyl material sourced at the Scrap Box in Ann Arbor Michigan. A single sheet of three eighths inch padding extends down from the top of the back panel around the bottom and up the front of the pack behind the elastic exterior pocket. The bottom of the padded secondary pocket is suspended six inches off the bottom to protect

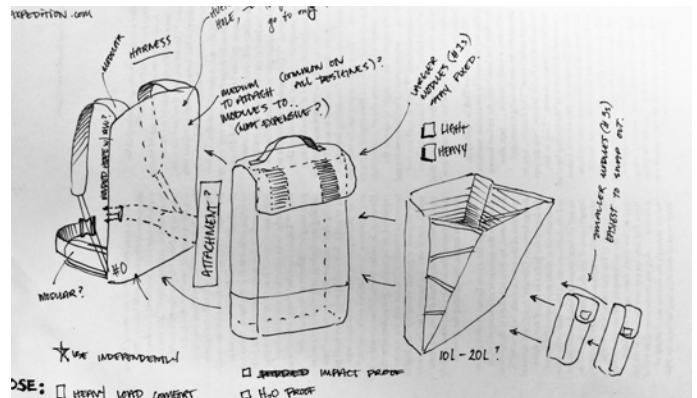


Fig. 7 - Modularity concept sketch. Matthew Grandin, 2011.

Simple-Basic Backpack Design

I believe I have created a backpack that mixes outdoor and professional organizational features with contemporary load-bearing theory (Fig. 8). I settled on a flap-top closure adapted from bicycle courier style bags. The benefit to the flap style closure is that there are no zippers to fail or leak water, also, the flap-top is self closing. You can never “forget” to close it. It is a very simple mechanism that by nature allows a moderate amount of expandability. If overstuffed such that the top flap can no longer reach the velcro on the body of the pack it can lay over protruding objects and be secured via the included buckles and straps. The large eighteen liter main

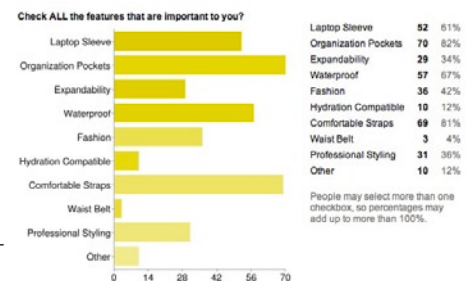


Fig. 9 - Common backpack feature importance rankings. HDYC Survey, Grandin 2011.



Fig. 10 - Simple-Basic Backpack, central pocket locations. Grandin, 2011.



Fig. 11 - Imminent strap-dangle danger. Grandin, 2011.



Fig. 12 - Simple-Basic Backpack, full and empty. Grandin, 2011.

fragile items when the backpack is repeatedly picked up and set on the ground. This pocket also features elastic side gussets to allow over-stuffing if the pack is full. The main pitfalls to on-the-go backpack efficiency is having to take the pack off to rummaging for items or to repack if you add something new. I chose to include a variety of exterior pockets to help with on-the-go organization (Fig. 10). The elastic exterior pocket on the front of the pack is accessible with the flap top fully closed. This pocket is perfect for quickly stashing snacks, flyers, clothing, gloves, chargers and cautionary items like bicycle locks, umbrellas or lightweight raincoats. The elastic nature of the side gussets allow the pocket to tightly hold inserted items with as few fastening actions as possible. For palm-sized on-the-go items (Fig. 12) the sides of the pack each have two mesh pockets, one above the other. The discrete lower pocket is made of opaque Spandura stretch mesh and is a perfect fit for all sizes of bottles or smaller items. Above this is an open-mesh flat pocket for smaller items like sunglasses, batteries, etc. The open mesh allows you to see easy to reach items inside.

The padded back panel features an internal High Density Polyethylene (HDPE) frame sheet with a removable padded waist belt. When combined, the back panel and waist belt effectively transfer load weight to the hips and off the shoulders. Dual density foam-padded shoulder straps with sternum strap secure the pack to the shoulders comfortably. Compression and closure straps for the top flap stow inside the elastic exterior pocket when not in use. This is done mainly to prevent dangerous strap dangle conditions among urban machinery (Fig. 11), but also distances the look of the pack from traditionally “outdoor” models. A predominantly black color scheme was used to agree with the status quo. A large effort was made to simplify the look of the pack as not to draw attention to precious cargo inside. I was interested in expandability because everyone wants the smallest bag possible when they carry a little, and the biggest bag possible when they carry a lot. When empty the Simple-Basic Backpack is quite slim and light, it’s easy to carry in various modern or rugged environments and can adapt when plans change.

Backpack Design Process

My design process started with a variety of conceptual sketches. I developed and refined concepts and ideas for an expandable backpack (Fig. 14). To allow users to further customize their packs to their exacting specifications I worked on the design and attachment of individual modules for specific items and their possible attachment methods (Fig. 13). With previous success attaching laptop sleeves and pockets inside messenger bags I plan to explore the idea of easy-to-use modular organizational cases for inside and outside backpacks.

I simultaneously began researching innovative materials and taking inventory of supplies readily available in my community. Some of the most innovative textiles on the market today are composites, textiles made up of more than one type of fiber or polymer (Bags Case Study). For example XPAC, Spectra and Dyneema fabrics all feature a stronger fiber loosely woven inside the fabric. The reinforcement permits higher yield strength while maintaining low weight. Industrial materials like Hypalon, uPVC, and PU (all used in Ridgid Inflatable Boats) consist of a woven fiber coated in a highly durable rubber, these materials are exceptionally durable and also waterproof,

however they are also quite heavy. I also browsed new material databases to see if there were any industrial materials that could provide customer benefit and might have been overlooked by other bag makers. Early on I found some heavy duty vinyl materials at the Scrap Box in Ann Arbor, a store which sells excess industrial materials to consumers for pennies on the dollar. I needed to dial in every detail of the entire construction even before ordering materials and hardware. A 2D backpack pattern was developed first on the computer, printed and taped together to confirm the fit of each panel and visualize the size of the compartments. Since I planned to construct a test-ready prototype considerations had to be made for the limitations of my manufacturing capabilities. Careful consideration had to be made in the layering of materials and positioning of stitches as not to overwhelm the sewing machine.

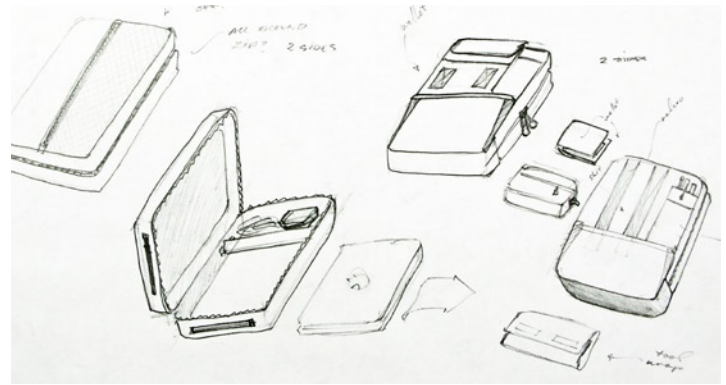


Fig. 13 - Modular laptop and electronics accessory case system designed to secure inside a bag yet be easily removable. Grandin, 2011.

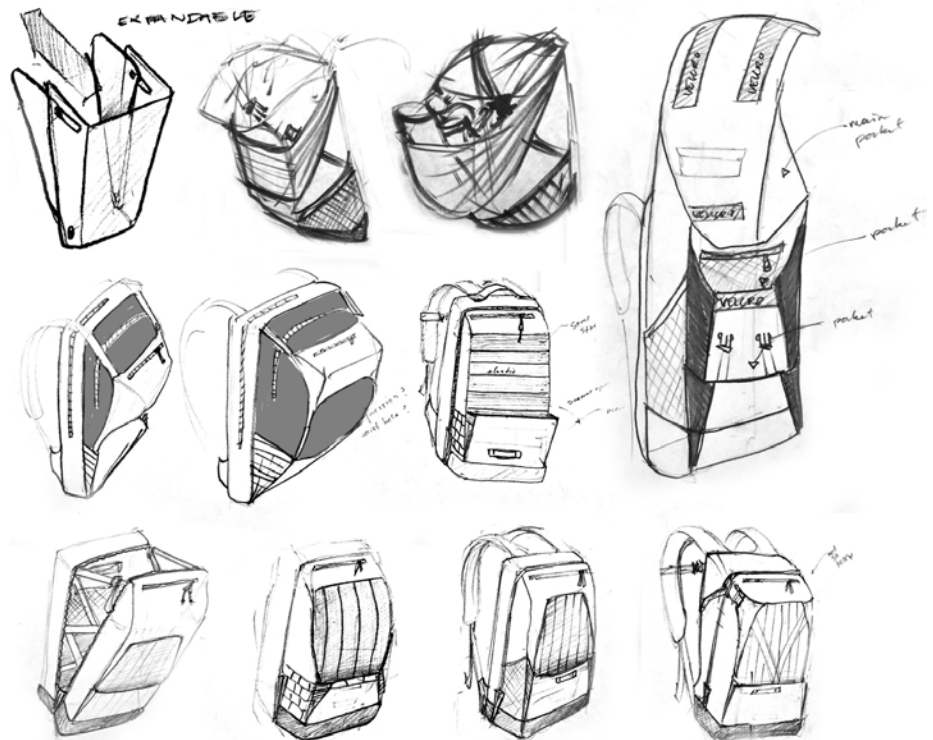


Fig. 14 - Developing and refining concepts for the expandable storage criteria Matthew Grandin, 2011.

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Figure 15 - Freitag Messenger Bags made from used truck tarps.

Materials and Better Business

As stated before my project has come to address two aspects of “carry,” improving products and improving the business. These two tracks diverged as I began to develop two separate products. I have always been intrigued with the concept of up-cycling where, contrary to recycling, “old products are given more value not less” (Reiner Pilz, 1994). Inspired

by business models like Freitag (Fig. 15) and Terracycle I went searching for interesting or surplus waste textiles. One of my early scores was an ancient bundle of tent canvas from The ReUse Center in Ann Arbor. With its repairs and blemishes the canvas had intense character and I could imagine guys laying in the dark with this tent above them chatting sleepily before bed. With the power of such aesthetic and conceptual heritage I knew this was something worth up-cycling. Since dealing with unique materials presents unique problems I decided to start simple. The Simple Basic Market Tote was born (Fig. 16). The first Simple-Basic Market Tote inspired a number of other material gathering trips and numerous other tote bags made by up-cycling waste or second hand textiles purchased at thrift stores. The elementary functionality of tote bags make them the perfect product to showcase unique culturally rich materials. Since all totes have more-or-less the same level of functionality the aesthetics are really the only way consumers choose to purchase a tote, this places a large responsibility on the material and construction alone. If I can sell my totes as designer fashion accessories I will succeed in turning garbage into gold.



Figure 16 - Simple-Basic tote made from vintage Army tent canvas and other found and secondhand materials. Grandin, 2011.

Bag Market Responsibilities and Backpack Health Issues

The utilitarian responsibility of the bag market is to provide robust, intelligent and safe carry products for consumers. Unfortunately some corporations have grown so large they can no longer control their own actions. Some have mastered selling marketing rather than products. Blogger KiscoDad expands on the marketing trends of ‘Back-to-School’ backpacks explaining, “For some reason my kids need new ones every year in elementary school because the old Super Man one isn’t ‘cool’ anymore and he needs a new Super Man one” (Kiscodad, 2010).

I attribute backpack health issues to shifting product categorization, urbanization, and misinformation. While ergonomic and functional technologies aimed at specific sporting activities have increased in complexity, backpacks available to the general public marketed as “bookbags” or “daypacks” seem to have decreased in ergonomic complexity from the Trager packboard of the 1920s discussed above. With the substitution of styling over function it appears that

backpacking best practices have been pushed into niche product segments unreachable by middle America. Increasing numbers of urban dwellers exacerbates this problem. They perceive less necessity to enter a camping goods store (where the majority of ergonomic backpacks are marketed and sold) and may be less physically fit than their rural counterparts to carry heavy loads in the first place. I argue that urban dwellers have just as much to gain from the outdoor industry's technological advancements as hikers and survivalists.

I find it particularly egregious that backpacks marketed to children for carrying heavy textbooks and laptops by-and-large have underqualified suspension features which increase risk of back stress and strain. An online survey by

Backpacks are...

- Good for:
 - Carrying books
 - Carrying laptops
 - Serving as makeshift pillows after a long night of studying in the library
- Bad for:
 - Posture
 - Body mechanics
 - Fashion

Signs your backpack is too heavy

5. Change in posture when you are wearing the backpack
4. You have to struggle to put on or take off your backpack
3. Tingling or numbness in your arms
2. Red marks on your shoulders
1. Pain when wearing your backpack

Figure 17 - Video stills from Backpack Ergonomics by Creighton University. Grandin, 2011.

Backpack Safety America reported that “89 percent of chiropractors surveyed responded that they have seen patients (ages 5-18) reporting back, neck or shoulder pain caused by heavy backpacks”. Furthermore, increasing loads for school children have prompted numerous scientific studies, concluding something the hiking industry has known for decades, heavy and low-quality backpacks cause back pain, strain, even long term problems. “If you’re carrying an older pack, you may find yourself stripping it off regularly to relieve shoulder spasms and tingling fingers. Conversely, a good, correctly fitted modern pack will rarely leave your back sore (same weight, more comfort). And the heavier your payload, the more critical the pack quality becomes” (Montoya, 2001). In *When Emily’s Backpack Weighs More Than She Does*, Curry explains why the current market exacerbates this problem among school children, “Many backpacks that appeal to children are ill-designed for the task at hand—carrying a day’s worth of school books, supplies, gym clothes, and myriad kid treasures. They may have the right movie character, but none of the proper padding and support to keep children from developing chronic problems with their backs.” (Curry, 2004) Un-

fortunately ergonomic load-bearing backpacks today are still quite expensive, even entry level models are rarely under \$100. At this price point I understand parents’ hesitations to even consider let alone purchase such a bag.

Apart from the marketing endeavours of backpack makers, misinformation about safe use of backpacks is prevalent too. A video by Creighton University titled *Backpack Ergonomics*, produced to “prevent injuries related to carrying heavy things in your backpack”, over generalizes, stating that backpacks are bad for posture, body mechanics and fashion (Fig. 17). It fails to address the behavioral and usage issues regarding conscience packing and proper load bearing. It assumes all backpacks are created equal and fails to educate its students about advancements made in harness technology that allow safer carrying of heavier loads. The video also perpetuates the social prejudice that backpacks are unfashionable. It does correctly recommend carrying the load below your shoulder blades but on top of your hips, close to your center of mass and if possible to wear the chest or waist straps, and to limit your load. It is correct in advising packing heavier items closer to your back, however for someone carrying 5 textbooks this doesn’t really apply. To further confuse those seeking load-bearing and health information there are published scholarly studies that seem to contradict each other (CONCLUSION: Both backpack weight and length of time carried influenced cervical and shoulder posture. Carrying weights of 15% of body weight appeared to be too heavy to maintain standing posture for adolescents. vs. CONCLUSION: Statistically significant associations between back pain and backpack use. No significance between backpack weight and back pain, or ratio of backpack weight to body weight.)

For better information on backpack safety for school children I would recommend a video by Backpack Safety America found on their web site Backpacksafe.com. Alternately you could stop in to a reputable camping and hiking goods store for proper backpack fitting and a more ergonomic selection of packs designed to safely carry heavy loads for extended periods.

Conclusion

Backpack health issues are reaching wider audiences due to the internet and mass media. Luckily most of the technology needed to alleviate these health concerns has already been invented and just needs to be applied. If consumers can be more conscience about the weight they carry in their pack, carrying it in the appropriate product, they will be more comfortable and have better posture in the long run. If a carry-goods company can successfully help consumers make the necessary lifestyle changes to decrease loads and carry more intelligently then I believe they will be profitable as well as admired. I imagine an expansive system of modern civilian modules which attach into or onto backpacks for sale on the web. Customers could read comprehensive descriptions of products and choose those that fit their needs. I succeeded in developing a backpack with intelligently proportioned compartments which could be modified to accept more modular components in the future. Modular components were tested inside of messenger bags and have not yet been integrated into the Simple-Basic Backpack due to the construction complexity and my inexperience in sewing. Modular components like a removable laptop sleeve and removable pocket structure affixed with large pads of velcro show promise in increasing user efficiency and allowing user customization.

My project did not reach a clear end and will continue into the future. All of the research channels that I explored serve as a solid foundation for ongoing inquiry. I plan to continue to post on Bag Blog about industry innovations in load bearing, specific-recreation backpacks and construction technology. With nearly 90 survey responses and counting I am drawing new conclusions from the information daily. The goals of the HDYC survey were exploratory in nature and the data is a bit scattered. I look forward to drafting a new survey with clearer goals and more comprehensive questions covering broader issues like perceptions of the carry market, physical and ergonomic beliefs and other social factors which impede the diffusion of safe backpack usage (like reluctance to wear waist belts).

Due to the limitations of my sewing equipment and sewing skill I was not able to construct as many iterations of the Simple-Basic Backpack as I would have liked. As a direct result the pack has undergone very limited field testing. In the immediate future I plan to use and abuse the Simple-Basic Backpack constantly to asses along technical and functional criterial it in as many situations as possible. Overall I feel like the scope of this project was much larger than eight months would allow. I have developed a personal interest in efficient carry methods and plan to continue further work on the topic in the future. Please visit <http://www.mattgrandin.com/> for further project updates.

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