



A Study On The Relevance Of Ergonomic And Anatomical Handles In Product Design

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Abstract: Design of the handle of any product is an important task. Handle designs significantly determine the productivity, user experience and the health of the user in the short and long term. This article is a study mainly about a specific category of product handles, referred to as anatomical handles. In the article, first, common paradigms of product handle development are discussed. The idea of classification schemes to understand the paradigm of design and making of product handles by their makers and sellers is later described. These become the basis for the authors to then systematically examine first, the concept of ergonomic handles, their importance and the scientific basis for designing these. Finally, the idea of anatomical handles is examined with the help of supporting literature from scientific research and industry. Reliable product and research literature indicates that anatomical handles offer multiple special benefits to users with special needs and tasks with special requirements. This study performs the task of offering greater scholarly visibility to anatomical handles, specifically in relation to the idea of ergonomic handles.

Index Terms – Anatomical handle, ergonomic handle, product design, hand tool, marketing literature.

I. INTRODUCTION

Handle is an integral and vital part of any hand tool or hand operated product. This article is mainly about the concept of a specific kind of product handle type referred to as anatomical handle. The Merriam-Webster Dictionary [1] defines a handle in the following manner –

a part that is designed especially to be grasped by the hand (1.1)

The Oxford Languages resource [2] defines a handle as –

the part by which a thing is held, carried, or controlled (1.2)

A handle is therefore a part of a product which is just grasped by the hand, or, by which the thing is held, carried or controlled.

Hand tools constitute a vast category of consumer and industrial products. Their production and consumption have only seen growth across decades, and across global markets. The critical relevance of such products to the human civilization can be understood by the size of global hand tools market, which was USD 22.29 billion in 2020 and is projected to grow from USD 22.97 billion in 2021 to USD 30.48 billion in 2028 at a CAGR of 4.1% during the 2021-2028 period [3]. These figures provide ample cues to indicate at why the design of the handle feature in a product is such an important design activity.

1.1 Who designs handles and why?

When considering handle design and development, broadly speaking, this activity could be investigated in the following settings – (1) commercial, and (2) non-commercial.

1.1.1 Commercial setting

In a commercial setting, handles may be designed to serve – (1) functional demands; (2) non-functional demands, or; (3) hybrid demands (significant consideration of both functional and non-functional demands). An easy way to identify examples of functionally purposed handles is to browse through handle-based products on any e-store. There, the functional handles could be typically found available with products which have large numbers of purchase record, are reasonable priced, and have a fairly large number of moderate-to-positive reviewer ratings. For e.g. the nylon handle on Taparia WCB series bevelled edge chisel [4] (see Fig. 1(a)).

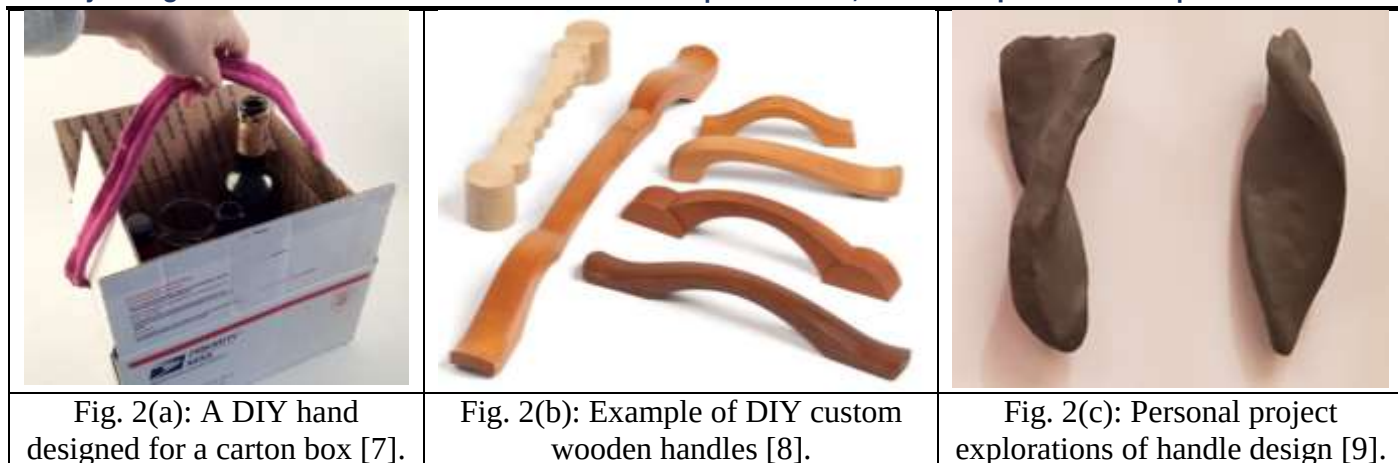
When it comes to non-functional handles, examples might be cases where the handle primarily serves a symbolic or, a mainly aesthetic purpose - such as a mainly decorative, showpiece item, or say, an artefact developed as a museum exhibit [5] (see Fig. 2(b)). But, different than the previous 2 categories, in the case of a vast majority of products meant for commercial use, handles may also be designed to serve a purpose which is a significant combination of the previous two categories. For e.g., a commercially available and popular Robert Sorby brand of octagonal satinwood handled bevel edge bench chisel provides excellent versatility of the woodworking operations of its user [6] (see Fig. 1(c)). At the same time, its classic London pattern octagonal handle, and the brand name are significant symbolic factors that may also invite valuable consumer appeal as well. Therefore, the intent behind designing a specific handle for the manufacturer could be either mainly functional, or mainly non-functional, or a significant mix of the two.

		
Fig. 1(a): Taparia WCB series bevelled edge chisel [4].	Fig. 1(b): Anthropoceni by ZPS studio from the “Tools for After Design Exhibition” [5].	Fig. 1(c): Robert Sorby bench chisel [6].

1.1.2 Non-commercial setting

Examples of non-commercial contexts for handle design and production are, for e.g. handled artefacts made chiefly for the purposes of creative exploration and self-consumption. Also, the motivation for making could be to enhance the convenience, overall usability, and comfort of the user. These handle design interventions could also be examples of workarounds, or fixes that a user might be deploying to deal with specific material handling challenges. For example, to carry a carton box, a rope and scraps may be used to develop a makeshift handle feature [7] (see Fig. 2(a)).

The examples in non-commercial settings could also be those of the handles developed by woodworking hobbyists or enthusiasts as personal, or do it yourself (DIY) projects [8] (Fig. 2(b)). They could be directed at creative exploration and experimentation [9] (see Fig. 2(c)), or an outcome of leisure activity or hobby. These might also come as a response to an academic assignment, with no specific, or original intent of commercializing the designs.



1.2 Handle classification by manufacturers

Classification schemes of handles are generally specific to a particular product line, as well as to a manufacturer. Product manufacturers and retailers could engage in making, cataloguing, as well as formally documenting and highlighting the different categories of handles that are put on offer. For e.g. table tennis bat handles have been classified by the Madison Sports e-store [10] in to 2 broad categories namely - Asian and European (Fig. 3). The details and sub-classification of this scheme, as indicated by the store on their official website has been provided in Table 1. With regards to making the selection by the customer, the e-store has additionally published the following information on their website [10] –

The choice of the handle is a very personal decision. There is no “best handle”, everyone has to choose their handle to their own taste. Straight handles normally are held more “loose”, concave and anatomic ones are held relatively “firm” in the hand.

When coming from reliable manufacturer or retailer, such information regarding user choice of handle is typically based on pragmatic understanding of the markets, consumer choices and design trends. This statement also serves to affirm the need for, and value in designing customized and personalized handles to address the needs of different kinds of users.

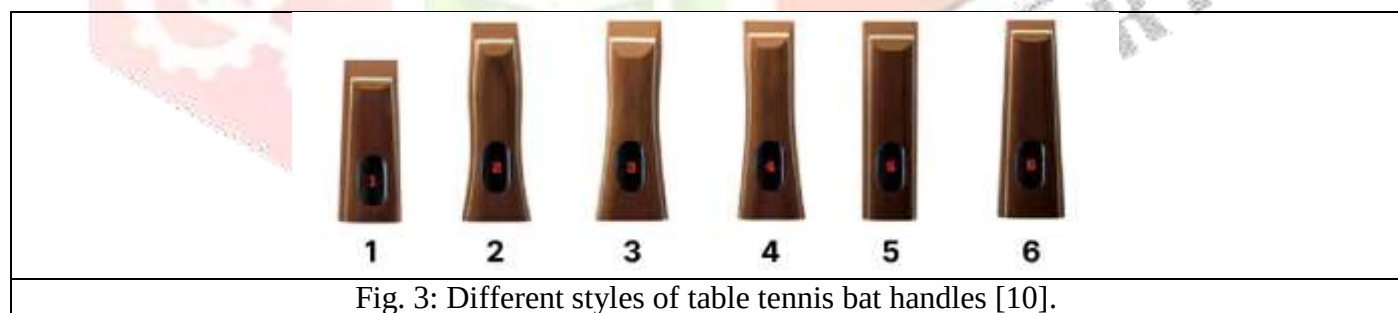


Table 1: Classification of table tennis bat handles by Madison Sports e-store [10].

S. no.	Broad classification	Sub-classification	Design description by the retailer
1.	Asian handle	PEN CH (Penholder Chinese)	Conical design. Short style.
2.	European handle	AN (Anatomical or Winner)	The anatomic grip is shaped to fit perfectly in one's palm. Recommended for larger hands it seems relatively thick and allows a firm grip.
3.	European handle	FL (Concave/Flared or Master)	With the shape of a swallow's tail, the flared grip prevents the blade from slipping. It lies firmly in one's palm, yet it is relatively flexible.
4.	European handle	ST (Straight or Classic)	The straight handle supports every blade grip with emphasis on an active use of the wrist.

5.	European handle	CO (Conical or Champ)	Exclusive handle from STIGA, old style. Now is not produced.
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Handle type classifications could vary, as described by one business or another (the classifications provided in [10] and [11]). For e.g. a different classification scheme of table tennis handles (than the one in Table 1), is also offered by OSP Blades e-store [11]. Here, these handles have been classified as – (1) classic flared; (2) squared straight; (3) round straight; (4) conical, and; (5) the anatomic. Such classifications may be developed independently by businesses to sometimes describe the range of models available with the maker or the e-store. For scientific considerations therefore, given a specific product category, none of such classification schemes may be considered as entirely “comprehensive”, or a standard. For, as long as there are different manufacturers making different designs, there would always be a scope for different and newer classification schemes and category names to emerge.

The utility in referring to, and analyzing the existing handle classification schemes is perhaps that they provide an understanding of the actual everyday use and applications of the product - as understood by the makers and sellers of these products. Therefore, the handle classification schemes could provide a valuable glimpse in to the different basis for developing different geometries of handle designs. This basis could be many different functional, non-functional or hybrid criteria; such as, considerations of the design processes (e.g. a monolith design, or assembled handle, etc.), operational competencies of the maker/seller (e.g., economy, or luxury handles, etc.), the marketing, sales and business strategy around the product (for e.g. re-used wood handle, 3D printed, hand-crafted handle, etc.), etc.

1.3 Aim of the study

The aim of this study is – (1) to establish the importance of handle design; (2) to discuss the practice of classifying handle design models by manufacturers and sellers, and; (3) to review scientific literature to discuss the importance of ergonomic handles and anatomical handles. The first 2 aims have been discussed in the Introduction section. Results from the review of scientific and reliable marketing literature has been provided in the following section.

II. METHODOLOGY

The authors have conducted rigorous review of different research article repositories, initiated from the resource search through relevant keywords on Google Scholar [12]. These keywords were – (product/tool) handle design, ergonomic handle, anatomical handle, and (product) handle classification. Specific scientific literature which was found relevant to this article has been discussed and cited across the article. Additionally, the authors also searched the Web on the Google Search portal [13] using the same set of keywords (as mentioned earlier), and referenced information about handle designs published by different manufacturers and sellers.

III. RESULT & DISCUSSION

Handle design is an important task. It has also been discussed in Section 1.2 that manufacturers and sellers have specific motivations behind making and selling products with different designs of handles. An important term which is popularly invoked and referenced in marketing and scientific literature for well-designed product handles is ergonomic handles. According to the Oxford Languages [2], the term ergonomic means –

relating to or designed for efficiency and comfort in the working environment (3.1)

When designing ergonomic products, in addition to ensuring an appropriate fit to the work system, the considerations of user health are very important [13]. In specific relation to the design of ergonomic handles, their examples and key characteristics have been discussed in the following section.

3.1 Ergonomic handles

When designing for functionality, the specific applied context and the details of the work system are important to be considered. A handle which is designed to meet the considerations of a specific user's health, and which provides a good fit with a specific work system, may be referred as an ergonomic handle. For example, the Fiskars Easy Action Shears [14] (Fig. 4) is designed with an ergonomic handle. The company considered the following ergonomic features in the handle – (1) a spring-action design that gently opens the blades after each cut to greatly reduce hand strain and fatigue while cutting; (2) soft grip touchpoints to offer excellent comfort and control; (3) a bent handle design keeps materials flat for precise cuts every time, and (4) accommodates both right- and left-handed users. Such product features of an ergonomic handle shall typically result in the users achieving high task productivity and comfort.

For good ergonomics, different contexts of work may require the design and development of very specific designs of handles. The specificity of design for the users also ensures a good fit, and this often translates in to designs which can be termed as ergonomic. In order to arrive at such context specific ergonomic designs, some of the important parameters to be considered have been discussed in the following sub-sections.



Fig. 4: Ergonomic shears [14].

3.1.1 User health and comfort

Reduction of muscle fatigue is an important benefit often offered by ergonomic products. Ergonomical handles are known to reduce the effort required by muscles, minimizing fatigue. Research shows that ergonomic handles decrease muscle activity in the forearm and hand muscles, making tasks less-tiring [15]. Also, ergonomically designed handles help in preventing Repeated Strain Injury (RSI), which is a common affliction in tasks involving repeated hand and wrist movements [16]. Researchers have also found that ergonomic handles significantly reduce the risk of developing conditions like Carpal Tunnel Syndrome [17]. Product manufacturers often market their handle designs by highlighting their benefits for users ailing with pre-existing health conditions such as Arthritis, Rheumatism, Parkinson's, etc. [18]. Over time, using tools and objects with poorly designed handles can lead to chronic musculoskeletal disorders [19]. Use of ergonomically designed handles can prevent development of such disorders.

3.1.2 Biomechanics and force distribution

Optimized force application is another important concern when designing ergonomic handles. Good handle design ensures that forces are distributed more evenly across the hand [20]. This is crucial in reducing localized stress and preventing injury [21]. Scientific studies have demonstrated that handles with larger surface areas and appropriate contours lead to better force distribution [22]. Additionally, ergonomic handles can also offer the users with improved grip strength. Research indicates that handle shapes that conform to the natural grip patterns of the human hand enhance grip strength and control [23].

3.1.3 Efficiency and performance

Enhanced task performance is an important feature of ergonomic products. Handles designed ergonomically have been found to improve the overall performance and efficiency of tasks [24, 25]. Various studies have found that workers using tools with ergonomic handles completed tasks faster and with greater accuracy [26]. Also, the use of ergonomic handles has resulted in reduced errors and injuries by providing a secure and comfortable grip [27], and reducing the likelihood of slipping and mishandling [28].

3.1.4 Psychological comfort

Multiple researchers in the past have indicated that the use of ergonomic products improves the overall user satisfaction [15]. Research in consumer ergonomics shows that perceived comfort and ease of use significantly influence the overall user satisfaction and preference [24]. Therefore, concerns for user comfort need to be mindfully addressed when designing handle. From an important research work, the following factors have been identified by researchers to model the experience of hand tool comfort – (1) functionality; (2) posture and muscles; (3) pain in hand/fingers; (4) hard surface; (5) handle characteristics, and; (6) aesthetics [29]. Since, comfort is an important subjective, psychological and multi-dimensional human experience that is impacted by the handle shape design, the design of handles assumes vital importance when designing products [30].

3.2 The anatomical handle paradigm

At this point in the article, it is fairly well established that ergonomic handles are well suited to meet the most important functional needs of the users and the work system. An interesting paradigm of ergonomic handle design is the case of anatomical handles. Anatomical handles are an important category of product handle geometry which have been found to meet the user and work system needs very well, especially when personalized use of the product is expected. Such has been the positive impact of well-designed anatomical handles on users that scientific and product marketing literature have interchangeably employed the expressions anatomical handle and ergonomic handle [24, 31]. The idea of anatomical handles, their key characteristic features and benefits have been described in the following sub-section.

3.3 Anatomical handles

An important handle design paradigm referenced primarily in the functional and ergonomic handle traditions is the design of what may be termed as anatomical handles [24-25, 30]. The dictionary definition of the term anatomical according to Oxford Languages [2] is –

relating to bodily structure (3.2)

The definition according to the Merriam-Webster Dictionary [1] is –

of or relating to anatomy or the body structure of organisms (3.3)

With these definitions in consideration, a logical description of an anatomical handle could thus be framed. Hence, the authors propose that anatomical handles are those handles which geometrically resemble the anatomy of the human hand inner grip. An example of such geometry is the handle design form of the Asterom Vesper Walking Cane [32] as shown in Fig. 5.



Fig. 5: Example of an anatomical handle [32].

3.3.1 Scientific literature in anatomical handles

The term anatomical has been used with the qualifier of a shape or a structure in important ergonomic handle design and evaluation literature, such as [30] and [33]. In [33], the authors provide a novel approach to design and development of an anatomically shaped handle based on the use of 3D scanning technology. In [30, 33],

the researchers found that an anatomically shaped handle was superior in user comfort than a traditional handle on most evaluation parameters derived from a comfort questionnaire for hand tools (CQH).

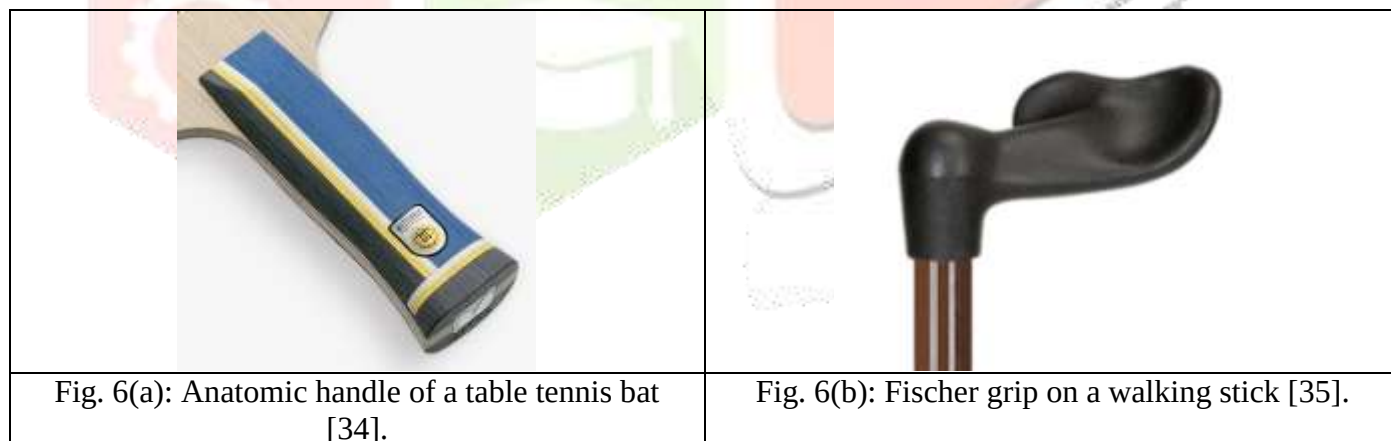
The term anatomical handle has also been referenced by researchers in other important literature which investigate the impact of the anatomical handle design on parameters such as work efficiency, levels of comfort and hand pain in the context of scraping task of woodworking chisel [24-25]. In [25], the authors found that anatomical handle was assessed as more comfortable than multiple conventional handles in a token task of cutting clay workpieces. In [24], researchers found that in comparison to other 7 standard handle designs, an anatomical handle was assessed as the most time efficient, comfortable and least painful in a woodworking chisel-based wood surface scraping task.

3.3.2 Anatomical handle in established domains

It seems pertinent to indicate that even today, there are already domain- or industry-specific references that are being made to anatomical handles. One such handle category is already mentioned (in Section 1.2) for the design of table tennis bats and is termed as anatomic handle [11]. According to the Butterfly e-store [34], the anatomic handle is designed to fit perfectly in the palm. It is recommended for larger hands due to its relatively thick shape, allowing for a firm grip. The handle has a wavy design that fits the entire palm comfortably, making it a recommended handle for beginner players (see Fig. 6(a)).

Another commercial example of the anatomical handle is the Fischer handle, invented by Dr. Franz Fischer [35]. It is an ergonomic design of handles commonly used for walking sticks or canes (Fig. 6(b)). It features a contoured shape that conforms to the hand, providing a comfortable and secure grip [36]. This design helps distribute weight evenly, reducing strain on the joints, making it ideal for individuals with Arthritis. Other marketed benefits of the handle include descriptions that this handle leads to enhanced grip due to the wider palm area, reduced joint strain from better hand and wrist alignment, and improved stability and balance.

There are a variety of important and interesting functional and non-functional considerations and motivations for designing anatomical handles. A detailed and highly engaging account of these ideas, based on the marketing literature published by contemporary businesses has been provided in [37].



3.3.3 Ergonomic anatomical handles

In the previous sub-sections, multiple marketing and scientific literature have been referenced to discuss the benefits of anatomical handles. Multiple references have described how the use of anatomical handles could improve the ergonomics in specific user work conditions. Anatomical handles have been found to be appropriate for tasks by different users and across different work systems. Importantly, anatomical handles have been found to be more comfortable than traditional handles in multiple studies [24-25, 30]. Therefore, in various traditional and specialized contexts of scientific research and commerce, the expression ergonomic handle is used interchangeably with anatomical handle [25, 32].

IV. CONCLUSION AND FUTURE SCOPE

This article is about highlighting the concept and idea of anatomical handle design. In this article, this has been done in a systematic manner by discussing – (1) the importance of handle design in products; (2) the intent behind making different handles; (3) the idea of classifying handle designs; (4) the paradigm of ergonomic handles, and; (5) the concept, examples and importance of anatomical handles. The core ambition of this article is not to merely discuss and highlight the idea of a anatomical handle, or provide a unique definition to the term. Instead, this article has been drafted to make the research community, product manufacturers and sellers more aware of the idea and potential of anatomical handles. It is with this intent that multiple references to anatomical handles used in popular products, and their development and investigation in scientific literature has been provided. This scholarly effort could result in realizing important opportunities available for designing even better and more ergonomic, anatomical handles.

In the future, product manufacturers and scientific researchers could systematically investigate, manufacture and sell well-designed anatomical handles with appropriate consideration of the handle properties, their benefits and the past-present-future challenges. The authors firmly believe that anatomical handles certainly seem to hold the potential to benefit the society significantly by offering product personalization, and greater user comfort.

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