

Is it Possible to Quantify the Functions of the Dress? a question for functional analysis methods in design

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Sent: 31/05/2019 // Acept: 27/08/2019


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ABSTRACT

When we face the study of dress from its artifactual identity, we observe that its so-called functional dimension cannot be understood in the same terms proposed by the ergonomics of the product, that is, from the ergonomic concepts of usability, efficiency, effectiveness and psychological comfort in relation to a specific activity or work.

This article, presents the results of a review of the functional analysis methods commonly used by design for the study of clothing, and explains why they are insufficient or limited to address the multiple functions of this particular artifact. At the same time, it proposes some considerations for its functional analysis that contribute in a decisive way to the design process of the clothing design.

Keywords: clothing design; functional analysis methods; clothed-body.



¿Es Posible Cuantificar Las Funciones Del Vestido? una pregunta por los métodos de análisis funcional en el diseño

RESUMEN

Cuando nos enfrentamos al estudio del vestido desde su identidad artefactual, observamos que su denominada dimensión funcional no puede ser comprendida en los mismos términos en que se han abordado tradicionalmente otros artefactos diseñados, esto es, a partir de los conceptos de usabilidad, eficiencia, eficacia y confort psicológico en relación a una actividad o un trabajo determinado.

El presente artículo, presenta los resultados de una revisión de los métodos de análisis funcional comúnmente usados por el diseño para el estudio del vestido y enuncia por qué resultan insuficientes o limitados para abordar las múltiples funciones de este particular artefacto. Al mismo tiempo, propone algunas consideraciones para el análisis de esta dimensión que aporten de manera decisiva al proceso proyectual del diseño del vestir.

Palabras clave: *diseño de vestuario; métodos de análisis funcional; cuerpo-vestido.*

1. INTRODUCTION

The study of dress, from a design perspective, needs to start from the two fundamental aspects that encompass its identity as an artifact: its particular intimate relationship with the body and the integration phenomenon between subject and object that happens while it is being used. Both aspects get together in the *body-dress* concept (FERNÁNDEZ-SILVA, 2016)¹, which allows analyses of this artefact to be made from this insoluble relation.

In the project process, the relation between subjects and objects while being used is studied in three dimensions: aesthetic-communicative, functional-operative and technical-productive. These dimensions are always present, interweaving in the material solutions' configuration, and are only separated when being analysed. For the functional-operative dimension, design gets hold of several disciplines and fields of knowledge such as ergonomics, biomechanics, and anthropometry. Each one of these areas brings its own categories and methods of analysis which, generally speaking, have been supported, both by academic research and classroom experiences.

In his book *Ergonomía Básica* (2015) (Basic ergonomics), Jairo Estrada defines the scope of this ergonomics specificity as being in charge of "designing products while considering

¹ Fernández-Silva in her doctoral thesis *Dress as an artifact of design: Contributions for its study and reflection within the design thinking* (2016), takes the literature of the dress and fashion, the expression body-dress, and builds arguments to transform it into a concept that contributes to the study, understanding and analysis of the dress' use phenomenon. Consequently, she states that: "every time the expression body-dress is used, it will be understood as a concept that operates in two instances: as a unit and mutual determination, and as an action applied to the body -in this case, to modify it or complement it.

From this stipulation, it is stated that the body-dress design project "as an operative, individual or collective anticipation in a desired future" (BOUTINET, 1990, p. 13), addresses both, the relationship between person and artifact and the getting-dressed practice as repetitive body artificiality process. The latter, getting different shades in cultural and social life. Both, relation and practice, being integrated in body entertainment acts." (p.162)

their usability criteria” (ESTRADA, 2015, P.20). On the same page, the International Labour Organization (ILO) in the *Encyclopaedia of Occupational Health and Safety*, published on 2012, broadens the range of ergonomics by stating that occupational conditions are amongst the main aspects of the concept of it. Said conditions cover from work organization to product design, including the dress in the latter.

However, -and with this being the main issue explored in this article- when facing the study of the dress from its artifactual identity, it is observable that to analyse its functional dimension the concepts of usability, effectiveness and efficiency related to an activity or particular job are insufficient. Both the concept of usability and the notions given by the human-computer interaction in cognitive ergonomics research (these notions gathered some of the considerations that are basis to consumers, individuals and people-centered design) applied to the study of the dress in design as a starting point, limit the research of the relation between body and dress. This, because they leave behind sociocultural aspects that can respond to issues related to gender or identity, amongst others, for they require a dialogue with other fields or disciplines and other methods to complement them.

The problem with the aforementioned methods is that:

Design is not only a way to fix countless practical and daily needs, but determines their meaning away from these paths. For being, what is designed, a means able to give meaning to people's daily life. (CABALLERO QUIROZ, BEDOLLA PEREDA, MORALES ZARAGOZA & RODRIGUEZ MOORALES, 2015, p. 6)

Given that the aim of the methods mentioned before is to quantify the human experience and generate data to be used in the process of design, some of the aspects of the

intimate relation that the dress suggests as an artifact -this relation, in itself, makes the essence of what is human, for all humans are dressed bodies- can be disregarded.

The fact, even if it seems unavoidable for artifact design, is relevant only in design actions linked to industrialization, serialization and widespread growth. From the most contemporary foci of design -ontological, transition, critical or debate design- the fact that quantifies human experience is questioned and replaced by knowledge of the place where meaning and subjectivity surface, shaping the unique and particular understanding of notions such as well-being, security and identity, which are neither comparable nor universal.

It is for the aforementioned that a revision of the transdisciplinary knowledge typical of design is necessary; to foster the study of the functional relation between body and dress, and coverage of that knowledge usual of ergonomics, but also medical sciences, engineering, biology, semiotics, sociology, philosophy, amongst others.

This article's objective is to present a reflection about the application of functional analysis methods, commonly used by product design and used in the study of the dress; and how they were, on occasion, limited or insufficient to cover the multiple functions of this particular artifact. To do this, the study started from a literature review about the concept of function of the dress and the applicability of the aforementioned methods in the classroom. As a result, some factors are proposed to address functional analyses of the dress that consider its particularity as an artifact and can be taken into account in the project process.

2. THE FUNCTION OF THE DRESS

The question about the dress and its function has been addressed thoroughly by different disciplines and fields of knowledge -mainly anthropology, sociology, semiology and history- which main unanswered questions revolve around an interdisciplinary research field named *Fashion Studies*. This field gathers doubts around both sociocultural aspects of the fashion phenomenon and its relation with western dressing culture from a past and present perspective (BUCKLEY & CLARKY, 2014; VINCENT, 2009), and the industry and production oriented to fashion attires. It also has a wide production and exposure in *journals*. Alongside of this field, there is another important one that questions the functional relation between body and dress in non-western societies (KELLY, 2010, NEVADOMSKY, & AISIEN, 1995), generally analysed from the specificity of each subject context or country.

In the anthropological literature of the dress, it is possible to find a few studies about its function, mostly focused on the variations of its symbolic function in different societies (STORM, 1986; SCHNEIDER, 1987).

Another way to cover the understanding of the function of the dress as an artifact, comes from the premises of Fernando Broncano's technique philosophy (2006). The author observes how an artifact's identity is created from its own functions. These, defined at the moment of creation and use as an action to deliver other functions that may not coincide with the original purpose of the artifact's creation.

One artifact has two identity sources.

The first one, and the most important one, is made from the artifact's own functions and components that, through the design process, shape its form and materials selection. The concept of function has two elements: one causal, the conduct that makes a component or the whole device; the other -from which

function normativity stems from- historical: it explains why the component is part of the device. (broncانو, 2006, p.6) El concepto de función contiene, por su parte, dos elementos: uno causal, la conducta que realiza un componente o todo el aparato, el otro, en el que estriba la normatividad de las funciones, histórico: explica por qué el componente forma parte del artefacto. (BRONCANO, 2006, p. 6)

The second identity source of the artifact is given by its use. This use does not necessarily coincide with its function or the original purpose with which it was created.

Thus, the possibilities of an artifact through its functions are not the only pragmatic possibilities that this artifact has. On the contrary, users tend to establish genetic drifts in the reproduction of the artifact, caused by uses different from the ones it was designed for. (BRONCANO, 2006, p. 7)

This double identity of the artifacts is added to the possibility they give to shape individuals' identity. For the dress, as one of the most proximal artifacts, both identities - functional historical and use- get together in the individual experience of the body, for "clothing is the way in which people learn how to live in their bodies and feel comfortable with them" (ENTWISTLE, 2002, p. 12).

From the semiological theory, more specifically from Barthes (1967,1970) and Eco (1968) -who state that signs are all meaningful events in human society, such as fashion, traditions, shows, and daily-use objects- the dress is, both, object and sign, and has both a primary and a secondary role.

The dress' primary role, could be said, is that one for which it was created. According to Eicher (2013) this *what for* is to modify/complement the body. The secondary role is that communicative and/or symbolic one with which it can be designated, for instance, as part of a group or a specific

status in a community. When studying the origins of the dress, it is evident that its secondary role becomes mandatory. Such is the case in the anthropological studies framed in cultural relativism (BOAS,1940) and those from structural anthropology (LÉVI-STRAUSS, 1962). For these, the magical and symbolic reasons overpower the clothing practice of humans, beyond factors such as protection and weather, and must be understood in their particular action context². The main issue when describing primary and secondary roles of the dress come specifically from this situation.

If the primary roles are defined by the utilitarian aims of a device (what it can be used for), and the secondary roles are defined by the connotations derived from its use and cultural appropriation, one cannot forget that a ceremonial outfit -such as a wedding dress- has as a primary role to modify the body to be presented in the rite. In addition, its secondary role lays on all those historical and current associations given to the body -female social status, purchasing power, beauty standards, social success, amongst others, for it would be, by now, anachronistic, to relate a wedding dress with purity and chastity.

Different from other devices and artifacts -a chair for instance, which primary function is to let the body rest in a seated position; and its secondary role, in the case of being

² Stated by Lévi-Strauss (1962): "Even if, as we have shown, the depiction of a lace collar in miniature demands an intimate knowledge of its morphology and technique of manufacture (...), it is not just a diagram or blueprint. It manages to synthesize these intrinsic properties with properties which depend on a spatial and temporal context. The final product is the lace collar exactly as it is but so that at the same time its appearance is affected by the particular perspective. This accentuates some parts and conceals others, whose existence however still influences the rest through the contrast between its whiteness and the colour of the other clothes, the reflection of the pearly neck it encircles and that of the sky on a particular day and at a particular time of day. The appearance of the lace collar is also affected by whether it indicates casual or formal dress, is worn, either new or previously used, either freshly ironed or creased, by an ordinary woman or a queen, whose physiognomy confirms, contradicts or qualifies her status in a particular social class, society, part of the world and period of history" (47-8).

a throne, is to designate hierarchy and power- the primary role of a dress (a king's crown, for example) is to complement the body so it becomes powerful. This way, its secondary roles would be all the connotations associated to powerful bodies in a specific time and place. They can be to designate tyranny or divinity.

Furthermore, when analysing the use of the dress as a sign inside a culture, one cannot separate its meaning from the bearing body. As a result, the secondary functions of the dress cannot refer to the artifact in an isolated manner, but joint to the meaningful result of its relationship with the human body, to the intentions and effects of body modification.

Consequently, it can be defined that the question about the role of the dress can be addressed from three instances: a) its definition as an artifact, according to the anthropological arguments, as something that modifies and complements the body (EICHER, 2013), defines its proper or primary role; b) the different meanings that, in its modification action it gives to the body who wears it, would provide its secondary roles; c) additionally, time and place would determine variations on the primary role, this means specific modifications that, by altering use, lead to systemic functions such as those generated by the second order understanding³ that people have of the dress as final user.

These three types of roles are gathered in what Fernández-Silva (2016) determines as the two fundamental axes of the dress' artifactual identity: recreate the body and mutually determine themselves when being used.

³ Krippendorff (2006), states that the understanding users have of artifacts is different from the ordinary understanding -when they are 'inactive', with no relation to the body- It is also different from the one thought of by designers. (First order understanding).

When prescribing the dress' artifactual identity in some of the precepts of design related to the project, artifact and body, we can find that the role of the dress had to be understood, not only as being a body trait, but as a relational property in a determined cultural system, which can be seen in the transformations of the body. (p. 205)

However, when the general question of function, functionality and usefulness of the dress appears -or by the dress' simulated use in the fashion staging-, every concept tends to get confused for it lacks a study which coherently gathers the necessary notions for its understanding.

2.1. THE FUNCTION OF THE DRESS IN DESIGN DISCIPLINE

When talking about design and its relationship with the function of artifacts, there is a tendency to state that their function -in this case, the dress'- is tied to their quantitative, medical and utilitarian aspects. The literature review available about the concept of function of the dress, and the functional analysis methods from and for design, produce a fragmented understanding and some studies that sometimes ignore each others' results. These results can be placed in two inquiry lines:

From functional, operative and performance relations: This line is related with ergonomic studies, specially comfort (BRANSON & SWEENEY, 1991; SONG, 2011; MONTAGNA, SOUSA & MORAIS, 2018; GONÇALVES & LOPES, 2006; SOARES & REBELO, 2016; NETO, MONTAGNA & SANTOS 2017; AHAM & FALCÃO, 2017; RAVINDRA, 2012; WATKINS, 2016; GILSOO, 2010; GUOWEN & FAMING, 2018; SEYMOUR, 2008; DAS & ALAGIRUSAMY, 2015); and from

fabric functionality, which basis is engineering(LIU et all, 2018; MI et all, 2018; MINCOLELLI, 2019; SHISHOO, 2015; WILLIAMS, 2017; HAYES & VENKATRAMAN, 2017; MCLOUGHLIN & SABIR, 2017; ANGELOVA, 2015).From these two lines, two perspectives of the dress' function emerge:

Garment usefulness: articles try to define the clothing device globally as a system (dress, attire, wardrobe, clothing, garments) where the shapes are analysed in relation to the user. References and punctual solutions of design are scarce and are closer to ergonomically developed objects. Plus, most information is found in English.

Fabric usefulness: published literature where raw material functionality is discussed implies material engineering revision and material and textile patents. The references found are products of high complexity engineering lab studies. Regarding technical names, most information is in English.

Even though it is not the most recent published work, from the specificity of the design field, we can find one of the most determining references with Susan Watkins and Lucy Dunne and their book *Functional clothing design: From sportswear to spacesuit* (2015). Here, the authors study the dimensional relations of the dress, its biomechanical mobility with the human body, the new wearable technology, and ergonomic aspects of the environment in specific activities where clothing is important -spacesuit design, sportswear, firefighters and military uniforms design, amongst others-. This research, articulates operative functions methods for analysis and understanding of the dress. Thus, making a key precedent for this issue's understanding, for it promotes a tool guide to tackle particular clothing aspects from a design perspective focused on the user. Although the text is, so far, the most complete functional and operative analysis guide

for the dress, it does not specify how said methods connect and articulate with respect to the sociocultural design aspects for the analysis of the dress as an artifact.

According to Watkins and Dunne, the functional studies of the dress involve multiple knowledge, "to understand the clothing sciences, one must turn to methods and fields of knowledge such as mathematics, physics, technology, biological sciences and social aspects of humanity" (2015). The problem for design is that the current definitions are not articulated and the analytical perspectives are dispersed. Consequently, the usefulness study becomes extensive and complex for clothing designers, showing a lack of command of concepts and terminology of the various disciplines (ergonomy, materials engineering, biomechanics, anthropometry, amongst others) that are foreign to the designer. Thence, it becomes necessary to have a study where said concepts and definitions are compiled as information which the clothing designer can use for their creative process and, at the same time, contribute to the pedagogical practice in the study of the dress and design itself. Said study must include an analysis proposal that integrates identity, appearance and cultural characteristics of the design objects, to fully depict their complexity.

From the literature review, it can be seen how the dress' usability is only framed in the operative dimension and is understood as a concept that corresponds only to the anatomo-physiological efficiency of the *body-dress* relationship-which is linked to the usability concept (ESTRADA, 2015). This poses a problem for the everyday nature of the dress is understood as an aspect linked to appearance, and it is only to specialised dresses to which functionality is attributed to. The aforementioned can be evidenced in space suits, office uniforms, sports competition

wear, military uniforms, medical dresses, etc. (WATKINS & DUNNE, 2015). This way, the sociocultural roles of the dress become secondary in relation to its complex technical and operative functions, perpetuating the misconception that a functional artifact is that one that is highly technological and hyper specialized.

In response to the previously discussed, the following question emerges: is the functional dress a *gadget*? Here, we come across the issue of multifunctional design opposed to *gadget* design. Moles briefly explains a clear and concise rule on how to determine the difference between both objects (which can also apply to the dress as an artifact); it is to obey the rules of daily life. According to the author, an object with many functions is not useless when these functions are practical for daily life. On the other hand, a gadget falls under total futility for it encompasses a set of functions that have no efficiency in daily actions (MOLES, 1989).

It is worth remembering Bonsiepe's statement about the designers action: "industrial designers focus on the use and usability phenomena, meaning the integration of artifacts in daily culture. Their interests lies on the socio-cultural efficacy." (BONSIEPE, 1998, p.23). Thus, the dress as a daily use artifact, always present in human lives, is functional for it integrates all dimensions in its use and does not reduce them to service providers beyond the ones prescribed by culture, their artifactual descent and the specific context in which the bodies fit.

3. CHARACTERIZING THE FUNCTIONAL PROBLEMS OF THE BODY AND ARTIFACTS. FUNCTIONAL METHODS OF DESIGN.

To begin this analysis, we will start from the methods and processes suggested by the ergonomics for product design. In the ILO Encyclopaedia (2012), when referring to design for specific ergonomics group, the author, Joke H. Grady-van den Nieuwboer, suggests a product design methodology based only on human factors, efficiency, optimization of the relationship person-object, and the concept of *usability*.

Image 1: Ergonomic design process.

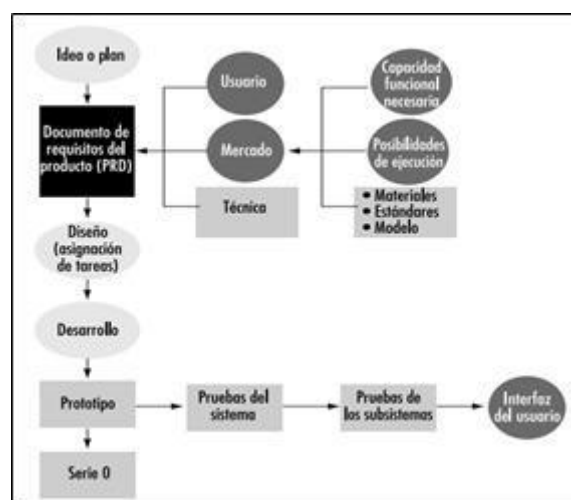


Image taken from the ILO Encyclopaedia of Occupational Health and Safety (2012, P. 29.85)

On the other side, the many action paths ergonomics has, allow it to relate to different fields such as design and the speciality of clothing design. This favours the questioning about physical, technological, biomechanical, anatomophysiological and environmental variables that surround the dress design in specific fields as diverse functionalities, working attire, sportswear, amongst others; for it explores issues where a job's or action's efficiency is determined by the relation between dress and human being. Nonetheless, even in cases where the ergonomic design method is pertinent, sociocultural aspects that go across different dress

types, are left aside, and cannot be standardised only by market studies.

Some of the variants of ergonomomy have made approaches to design by different concepts that lead to other reflection fields. Patrick Jordan, in his book *Designing Pleasurable Products* (2000), suggests a bridge between design and *human factors* through inclusion of pleasure as a *benefit*, being this a result of the interaction person-object. This response answers to the dehumanization mentioned by Jordan, which is caused by the transformation of people into *users*, due to the application of the concept of *usability* implemented by ergonomomy⁴. For this reason, Jordan refers to pleasure as a complementary element that appears after having covered the necessary needs. In spite of including social aspects in emotional design, these factors are placed from socially created conceptions of pleasure, which appear after the basic needs are met. In addition, Jordan's search for *pleasure* is driven by the relation person-object that begins at consumption.

Along with the previous idea of pleasure in the relation between humans and their artificial world, comes *hedonomy* as a concept and field of knowledge. In the article "A ergonomia e a hedonomia como conceitos no desenvolvimento de uma interface web" (2015), the authors Haro Schulenburg, Talissonn Buchinger, Marli Everling y Francisco Fialho, define it as a field of study centered on promoting pleasure in the interaction between humans and

⁴ As stated by Nora Angélica Morales Zaragoza, the naming of a concept indicated how we build our thinking around it. "In the 70s and 80s we called them 'clients' or 'consumers'. 'User' covers the end of the 80s and continues to date. Nowadays we are more prone to talking about the user or final user. A new approach is emerging, where we invite people, who we want to serve through design, to participate with us in the act of designing. We are starting to think about people as a participant in the process of design, as an adaptor of the design object and, on occasions, as co-creators. This last denomination implies equity and recognizes the subject as posesor of a unique experience" (MORALES, ZARAGOZA, 2015, p. 12).

technology (user-product) *Hedonomy* bases its relationship with ergonomics on their use of the concept of *usability* and how both reduce the person to a user, as pointed by Jordan (2000).

Another concept that relates ergonomics and design is *Ergodesign*. Luiz Agner, in his book *Ergodesign e Arquitetura de Informação. Trabalhando com o Usuário* (2018), explains how *Ergodesign* is theoretically based on ergonomics, and presents three ways to apply ergonomic data to the design project, amongst which we can find physical, emotional and cognitive ergonomics. When reviewing the fields, issues and benefits from each of later, the same emptiness presented by hedonomy is presented: a reference to the emotional and cognitive factors. However, leaving behind the aesthetic and symbolic factors, as well as the general link they all have with the sociocultural aspects that condition their understanding.

For this reason, when establishing the relationship between design and pleasure driven human elements (JORDAN, 2000), Hedonomy (SCHULENBURG, BUCHINGER, EVERLING & FIALHO, 2015; DE OLIVEIRA LIMA FILHO, 1973; GILAD & HANCKOC, 2017) and *Ergodesign* (AGNER, 2018), it is evident that those methods based on ergonomics are focused on the effectiveness of artifacts and, when communicative functions are being addressed, it is done from indicative functions and comfort. Finally, Jordan's proposal to reclaim the search for pleasure when used, shows contradictions. This, because it appears only when the user's basic needs are met and presents itself as an additional *benefit* when the artifact is already understood as a product in the market sphere. These methods, then, only make sense on artifacts designed from its consumption logic, from a context where the author places the company and,

with it, the conception of a person as a user evolves to that of a consumer.

What can be highlighted along with the previously discussed arguments, is that the complexity of design problems do not only include these aspects, but others that go beyond quantifiable data. Arturo Escobar points to this in *Autonomía y diseño: la realización de lo comunal* (2016) when he refers to the ontological bases of design and states: "Every design is for an action 'use' (but it does not only involve 'users'); produces operational efficacy (but not utility); fosters autopoiesis of living entities and heterogeneous life groups; is conscious of living in the pluriverse" (ESCOBAR, 2016, p.155). It is expected, then, that the proposal of ontological and transition design from authors such as Escobar points to an estrangement from the act of design of morent practices of unsustainability and de-futurization and a reorientation towards other compromises, actions and narratives that contribute to deeper cultural and ecological transitions. To that effect, these design foci promote a deep understanding of the place, body diversity, common logic and interrelations with the environment from a design practice that does not allow universalities.

Lastly, to place these needs specifically in clothing design, Claudia Fernández-Silva states, when defining the objective of the action of design centered on the dress:

The action of design is not so much directed to the creation of modifying artifacts -for this could be an action shared with craftsmanship or art- but to the creation of relational properties amongst bodies, dresses and contexts, which take different meanings and can be perceived carnally and materially on people. (FERNÁNDEZ-SILVA, 2016, p. 238)

Considering the concepts and disciplines previously studied, it is observed how they focus on artifact

development from their utility and usability. Said artifacts are understood from optimization and consumerism, leaving relational properties and implied factors behind.

At the same time, there is a field in biomechanics -study of living beings' movement- that focuses solely on the human body and the consequences movement has in human physiology. This field is called kinesiology and it studies working positions and the efforts they produce. Both biomechanics and anthropometry -study of human body proportions and dimensions- have been taken by design as ergonomomy tools, without taking into account how this discipline only takes the most pertinent strategies these fields use in order to fulfill its objective.

Regarding clothing design, the previously mentioned tools stop being only linked to ergonomomy and come together with size and body standardization (anthropometry) and working responsibility and its optimization (biomechanics). When separated from ergonomomy and tied to the analysis of the dress in design, these disciplines become study fields that allow the exploration of different dimensions of this artifact that concerns us and its relation with the body.

As an example of the aforementioned, there are Watkins and Dunne's analyses (2015) about the fields opened by the study of body dimensions and proportions in the relation body-dress. As a starting point we will refer to sizing and body standardization systems. Watkins and Dunne describe the circumstances where sizing methods are applicable, according to the type of user and the dress that is being alluded.

They suggest that sizing systems are used when production costs need to be reduced and complexity needs to be avoided when defining the garment's dimensions. This size standardization method is used when there is a big

group of individuals. In contrast, they also refer to personalization in garments development that allow for the inclusion of technological tools, such as 3D scanning (WATKINS & DUNNE, 2015). These will allow a deeper study of, not only, dimensions, but also, their relation with body shapes and curvatures.

Hence, separating anthropometry from ergonomics and relating it independently as the science which studies body dimensions and proportions (in design body-dress studies), opens up a new field of study, where it is recognized as only a part of it and not as a whole.

Additionally, in regards to biomechanics, Watkins & Dune separate biomechanics from ergonomics. This decreases the perception of biomechanics as a tool to study body effort and movement in a specific activity (usability), and encourages its understanding as an exploration field of the body-dress through movement. In their chapter *Providing Mobility in Clothing*, they state: "Since clothing is intended to be a *second skin*, there is no better way to being a study of mobility needs in clothing than by looking at the mobility of the body itself" (pag. 31). From this, the authors suggest different methods to analyse the body-dress relation through movement, which start from sensory aspects of this relationship. They study the types of mechanoreceptors and their relation from touch using vibration, pressure, or strokes, creating sensory maps of the body that showcase the consequences of a moving dressed body.

Likewise, the authors go on to examine the relation between the moving body and the implications of clothing patterns development. They question traditional pattern design and suggest alternate methods that can allow lines transformation -which tend to respond to a static body- to those that respond to the needs of a moving body. Amongst

these methods there are the wrinkles analysis or the body segments and movements relation from pattern design. They develop a pattern cutting and material selection relation that improve body movement.

However, understanding functional studies of the relation body-dress does not only imply biomechanical, anthropometric and ergonomic observation, but also other study fields that are not categorized nor defined yet, as stated by Watkins and Dunne (2015). They recognize, for instance, the importance of materials engineering as a field of study that allows the functional understanding of the dress and its relation to the body (by studying its material).

This is why understanding ergonomics as a discipline, and biomechanics and anthropometry as sciences that, instead of being linked to the designer's work, study the dress and its relation with the body for the design process, allowing them to integrate other fields of knowledge that feed the different body-dress analyses from a disciplinary perspective.

4. REDUCTIONIST EFFECTS: THE BODY AS A MEASURE

As it has been stated, when the dress artifactual identity is observed from a design perspective, one has to take into account the different fields to analyse its functions, and these cannot be limited by the ones prescribed by the product's ergonomics, for they have shown to be insufficient. This will be demonstrated next.

One of the biggest questions about methods derived from ergonomic approximations to body-dress analyses, is the quantitative understanding of the body they promote, for they elicit an abstract and reductionist comprehension where the body is only conceived as a measure, a machine or a standard. This quantifiable idea of the body is recurrent in

design, mostly when medicine and ergonomics preconceptions are present.

As stated by Fernández-Silva (2016)

The conception of the body as an accompanying measure of design history, has its origins at the beginning of the XX century; when experts in operations administration in the progressive era created a new way of industrial consultation focused on interactions between industrial equipment and human operators. Important characters such as Frederick W. Taylor in *The Principles of Scientific Management* (1911), suggested a selection of workers according to the type of body, that is, to design a workforce that fitted the physical requirements of certain machines and tools.

But it was only after the Second World War, with the appearance of a new design field in 'human' or 'ergonomic' factors, that the conception of the body as a measure for its application in design was settled from anthropometric methods⁵. The latter were kept as a norm in design for decades after the war. To get to a standard body measure the values considered atypical were eliminated. These were located at the extremes of the anthropological scale, even when statistical research showed that there was where the biggest variations in physical dimensions happened. Given that these ergonomists came from a military background, they had the option to eliminate those body types for which it became difficult to perform certain military operative positions. (p.199)

Using the terms of product ergonomics, Estrada (2015) outlines the objectives and scope of ergonomic design, which allows understanding of the body as a variable in a triad system (human-environment-object). This way of observing the body-dress issue gives us, as stated before, only

⁵ In military research labs, interdisciplinary teams of doctors, biologists, psychologists, anthropologists and engineers extracted medical information to use it in design, using 'anthropometrics' (human body measures) to determine design equipment that go from cabins to control panels and uniforms. (WILLIAMSON, 2012, p. 216).

quantitative information, which runs short for clothing design as the body cannot be studied unidimensionally.

For the researchers of engineering of functional clothing design, Lucy Dunne and Susan Watkins (2015), "the dress must be studied as an environment that packs the body". Thus, they propose a new way to see these quantitative and rational relations as a knowledge pack known as "science of the dress". This concept is clearly related to the theory proposed by industrial designer Cecilia Flórez in her text *Ergonomy for Design* (2001). Ergonomy, according to the author, understands about the tools that can give design objective readings about factors that imply user-environment-machine relations, all this linked to a medical vision of the body. As Ana Martínez Barreiro (2004) would say, the social link to medicine, the social body and the medical body are understood in the medical standardization, even though medicine only sees the body as something that is always sick and must be treated.

Said visions must be put into a dialogue with the sensitivity both, design and body understanding need to place their their objective functionality inside the discipline's frame. To place oneself only on the objective medical-rationale of the body side would devalue the relational power with the dress and all this artifact allows it to create and recreate.

5. FINDINGS AND CONCLUSIONS

Implications in dress design from economic factors

After knowing how, from ergonomics, dress design has been addressed from anthropometry and biomechanics inclusion -understanding these two as factors inside

ergonomy-, its accurate to know the implications of designing clothes from methods, tools and objectives of ergonomomy.

Ergonomy as a clothing design tool

After examining risks associated to body understanding from ergonomically analysis, it is important to clarify that we are not stating that ergonomomy, design and dress studies cannot be related. On the contrary, it is pertinent to define that, when talking about the dress, ergonomomy becomes a tool that allows the diagnosis and setting of design requirements linked to variables and specific need in the body-dress relation, without forgetting that it may fall short when designing clothing artifacts.

It is important to understand that all this happens due to the incapability of this discipline to standardize the project process of clothing design and the designer's job. It can be seen in Luz Mercedes Sáenz article results, *Ergonomía y Diseño, Análisis y aplicación para calzado laboral* (2008). When creating work attires, specifically shoe design, she states that one must take into consideration contextual, cultural and social variables. She concludes by saying: "Even though we have specific information about feet illnesses and pathologies, for users, visual and communication criteria weights more than function and comfort aspects of the shoe." (SÁENZ, 2008, P. 137).

From this, the need for a special field is confirmed. One field that can study the complexity of the relation body-dress, which, in this case, corresponds to the design and recognises the clothing designer as he who has the expertise and capacity to understand the clothing device in all its complexity. Just as Claudia Fernández states in her book *La*

profundidad de la apariencia. Contribuciones a una teoría del diseño de vestuario (2015), when talking about the implications of being a clothing designer:

It implies, according to what we have seen, to execute a series of actions that go from: a deep study of the body of the user; defining a problem or requirement of said body in relation to itself and its environment; an analysis of the many objectives in his action; and the definition of fundamental solutions from functional, technical and communicative aspects. (FERNÁNDEZ-SILVA, 2015, P. 74)

Use vs usability

Another implication to keep in mind is that one of the contrast between the concepts of use and usability, as well as the pertinence of each in clothing design and the study of its relation with the body. This discussion exists due to the application of the usability concept over the use concept in product design.

Taking this concept as a starting point to study the relation between body and dress, pushes aside the peripheral areas mentioned by Watkins & Dune (2015), which does not allow and equitable study from the communico-aesthetic, functional-operative and techno-productive dimensions and the relations that come up amongst them. On the other hand, Javier Bercenilla states that by applying the concept of usability to the study and development of design objects or daily life objects (like the dress), the short range of the concept is evident, for it excludes elements -like identity, taste or context- of the relation between people and objects.

Because of this, it is necessary to expand the study spectrum from the inclusion of the concept of use. This allows to respond to particular characteristics of the dress

(FERNÁNDEZ-SILVA, 2015), because, different from other artifacts, the dress is transported and moved with the body, making their relationship one of intimacy . In addition it exposes the dress to different contexts and places, no matter what clothing type it belongs to. The consideration and implementation of the concept of use -when using ergonomics as a tool for the study of the dressed body- will contribute to the creation of more tools that could be adapted to the peculiarities of the dress, understood as a design artifact.

Tools adaptation

Finally, when understanding ergonomics as a diagnostic tool, one must consider that, in order to become a tool for design, it has to adapt itself, its methods and the tools to the functional-operative, technical-productive and aesthetic-communicative needs of the dress. Sáenz, in his article *Ergonomía & diseño de productos propuesta metodológica para la docencia y la investigación* (2005), suggests the adaptation of methods of ergonomics from the interpretation of the design project, to be able to meet the specific needs that are going to be the focus.

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