Advances in Intelligent Systems and Computing 826

Sebastiano Bagnara
Riccardo Tartaglia · Sara Albolino
Thomas Alexander · Yushi Fujita
*Editors*

# Proceedings of the 20th Congress of the International Ergonomics Association (IEA 2018)

## Volume IX: Aging, Gender and Work, Anthropometry, Ergonomics for Children and Educational Environments

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# Advances in Intelligent Systems and Computing

Volume 826

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## Volume IX: Aging, Gender and Work, Anthropometry, Ergonomics for Children and Educational Environments

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# Preface

The Triennial Congress of the International Ergonomics Association is where and when a large community of scientists and practitioners interested in the fields of ergonomics/human factors meet to exchange research results and good practices, discuss them, raise questions about the state and the future of the community, and about the context where the community lives: the planet. The ergonomics/human factors community is concerned not only about its own conditions and perspectives, but also with those of people at large and the place we all live, as Neville Moray (Tatcher et al. 2018) taught us in a memorable address at the IEA Congress in Toronto more than twenty years, in 1994.

The Proceedings of an IEA Congress describes, then, the actual state of the art of the field of ergonomics/human factors and its context every three years.

In Florence, where the XX IEA Congress is taking place, there have been more than sixteen hundred (1643) abstract proposals from eighty countries from all the five continents. The accepted proposal has been about one thousand (1010), roughly, half from Europe and half from the other continents, being Asia the most numerous, followed by South America, North America, Oceania, and Africa. This Proceedings is indeed a very detailed and complete state of the art of human factors/ergonomics research and practice in about every place in the world.

All the accepted contributions are collected in the Congress Proceedings, distributed in ten volumes along with the themes in which ergonomics/human factors field is traditionally articulated and IEA Technical Committees are named:

I. Healthcare Ergonomics (ISBN 978-3-319-96097-5).
II. Safety and Health and Slips, Trips and Falls (ISBN 978-3-319-96088-3).
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Altogether, the contributions make apparent the diversities in culture and in the socioeconomic conditions the authors belong to. The notion of well-being, which the reference value for ergonomics/human factors is not monolithic, instead varies along with the cultural and societal differences each contributor share. Diversity is a necessary condition for a fruitful discussion and exchange of experiences, not to say for creativity, which is the "theme" of the congress.

In an era of profound transformation, called either digital (Zisman & Kenney, 2018) or the second machine age (Bnynjolfsson & McAfee, 2014), when the very notions of work, fatigue, and well-being are changing in depth, ergonomics/human factors need to be creative in order to meet the new, ever-encountered challenges. Not every contribution in the ten volumes of the Proceedings explicitly faces the problem: the need for creativity to be able to confront the new challenges. However, even the more traditional, classical papers are influenced by the new conditions.

The reader of whichever volume enters an atmosphere where there are not many well-established certainties, but instead an abundance of doubts and open questions: again, the conditions for creativity and innovative solutions.

We hope that, notwithstanding the titles of the volumes that mimic the IEA Technical Committees, some of them created about half a century ago, the XX Triennial IEA Congress Proceedings may bring readers into an atmosphere where doubts are more common than certainties, challenge to answer ever-heard questions is continuously present, and creative solutions can be often encountered.

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# Way-Finding and Communication Design as Strategic Systems to Improve the Well-Being of Children in Paediatric Hospitals

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**Abstract.** In recent years there has been a growing need to design way-finding systems and communication more effectively, as we realize the great importance they have in everyday people's life, becoming necessary and operative guidelines tools for improving the quality of life. Sometimes these tools are used as simple signposting or mere decorations designed to embellish a specific space, as happens in place dedicated to children. Instead they are very important and strategic instruments able to improve the liveability and usability of specific environment by different kind of users. Among these ones, the children are very particular, because they feel, think and behave in a very different way beside the adults.

Generally, the hospital environment causes a high level of stress in children. Indeed, because of their young ages, they have a very limited experience and therefore they do not have the psychological and emotional state to deal with kind of stressful environment.

Way-finding systems and communication design products improving the user experience, are able not only to orient children inside unknown spaces, but also to make "familiar" a place never seen before, making the child feels at ease, avoiding or reducing the stress that this place can bring to the user.

**Keywords:** Way-finding · Communication · Children · Well-being
Pediatric hospital

## 1 Introduction: Context of Reference

### 1.1 Wayfinding Systems

In our days people spend a significant part of their life outside home by living outdoor or indoor public spaces to live experiences or socialize with the others. During this kind of experience people need to "find their way". Sometimes they become disoriented in the event of there being difficulties in reaching their destination or in case of losing their sense of orientation during the journey. In such situations, way-finding systems help to keep guidance and give people the means to feel comfortable in new environments. In case of young people the problem is even more complicated because they have more difficulty in recognizing unknown or non-familiar places. Today there are

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just few examples of way-finding systems and communication design products, which are especially designed according to children needs and their psycho-physical and emotional characteristics.

Generally, way-finding systems dedicated to children are not easy to be found in modern cities' indoor or outdoor spaces. This is probably due to the fact that young people are always associate with an adult or live experience under the supervision of a helper. So, the guidance is demanded to the adults (parents, teachers, etc.) going along them. When children grow up and reach the age of over six/seven years, sometimes they succeed in following way-finding systems designed for adults, as, for examples in the underground big cities, such as an example Milan in Italy, because, in this case, the signs are clearly visible and recognizable, well organized, placed also on the ground (easy to see and follow). Moreover, each route is identified by graphic elements of a specific color. In spaces and along routes where way-finding systems are not installed, people follow undersigned signs they find in the environment. Indeed, this is the case, as instance, of urban scenarios, where they use for orienting shop windows, mail boxes, bus shelter, advertising signs. A similar case apply in indoor public spaces, where those elements are represented by lifts, stairs, corner, lights, signposting and so on. All of these elements realize spontaneous way-finding systems that often are not sufficient for navigation.

Unlike external environments, in interiors spaces dedicated to childhood such as schools, play-rooms and pediatric hospitals, actually it is possible to find few examples of way-finding systems. All of them are characterized by a vast wealth of colors and graphic elements, like stylized animals remembering tales and cartoons, which can be easily to recognized by children. "*In developing the wayfinding strategy and designing the sign system, the designer will have to create a family of sign types that not only addresses primary information and wayfinding needs but also recognizes secondary issues and audiences with an appropriate information hierarchy and sign-messaging protocols*" [9].

Furthermore "*symbol design is equally important to wayfinding. Symbols provide a shortcut way for large groups of people who may not share a common language to Communicate*" [9].

Generally, wayfinding systems are represented by different kind of "signs" inside connection areas, especially in the cities characterized by streets, path walks, squares, parks, gardens and playground. In the contexts, streets represent the connection areas used by people to go from one place to another, while the other urban spaces are also used for socialization and free time. In public interior environments the wayfinding systems have the same functions. The first one is practical or denotative [7] and consists in orienting people inside the space. The second "function", defined connotative [7] is related to the emotional sphere, it involves the senses of the users remembering familiar elements and actions and suggesting behaviors or relation among users.

As a consequence, we can state with a certain level of confidence that a way-finding design for little users could help them to feel comfortable even if they are in an unfamiliar space as a hospital, which is generally perceived as hostile.

If we consider children as main user of a collective interior space we can say that it is not easy to find interesting examples of places with way-finding systems designed at "children's size".

Generally speaking, the hospital environment causes a high level of stress in children. Indeed, because of their young ages, they have a very limited experience of life and therefore they do not have the psychological and emotional state to deal with kind of stressful environment. For this reason wayfinding systems and communication design products able to improve their experience as users, are able not only to orient children inside unknown spaces, but also to make "familiar" a place never seen before, making the child feels at ease, avoiding or reducing the stress that this place can bring to the user.

### 1.2 Pediatric Hospital

The hospital is a building which welcomes patients and dispenses a wide range of medical care services. To these, the medical staff and everybody who need to go in it, both patients and their relative, have be added. The pediatric hospital, from an organizational point of view, is mainly divided in three classes: hospitalization, diagnostic-therapeutic and general services.

Furthermore, there are also the spaces which host the machineries and those dedicated to didactics. Differently from a normal hospital, the pediatric have some peculiarities, first regarding the subdivision of hospitalization in relation to the patients' age. This is necessary due to the furniture, which is adapted respect to the specific measures of the children, accordingly to each age. In general, in the services class are included playing spaces, green spaces and those dedicated to didactics. All of those have a specific aim: entertain the children, distracting them from their illnesses, but also amuse the medical staff. The life in the hospital is perceived as extraneous by the routine and habits of everyday life. These are replaced by rules and strict rhythms of medical care. During the hospitalization experience can also incur relational problems, caused by a depersonalized environment.

There are indeed several studies that proved the importance of creative stimulation as a valid method to fight depression brought by disorientation and identity loss. As previously said, the hospital users are not only the patients, but also all the relatives which help them in carrying out the hospitalization or visit them. In every case, often, all the persons that are in the hospital, as main or secondary users, are requested to wait for. Consequently making enjoyable and interesting the transit and waiting places has been became of fundamental importance.

### 1.3 Children and Parents' Stress in Pediatric Hospital

Stress is a concept scientifically defined and an evincible phenomenon. In 1998, Evans and Mitchell McCoy, described the way a built environment may influence the health of persons and found which architectonic elements may lead relevant stress in the users. The characteristics of the building' spaces that may lead stress are basically four: stimulation, coherence, affordance and control.

In the hospitalization matter, the stress phenomenon assumes a relevance, because this may negatively influence the clinical outcome of the patient.

Subsequently to further studies and researches, two ways in which stress impact on patients' health were identified:

- Negatively impacting directly on health patients (physiological parameters: blood pressure, state of anxiety, depression, etc.)
- Negatively impacting on medical staff performances. In the hospital, in fact, may be found two types of stress: environmental and occupational.

According to Ulrich, Devlin, Arneill and Del Nord, the elements of the building that may represent possible stress vehicle for users are the following:

- The image itself of the hospital.
- Sensorial feelings.
- Difficulties, impossibility in control and manipulate the environment.
- Orientation difficulties.
- Physical discomfort.
- Viral risk.

**The Orientation Difficulties.** The orientation difficulties are typical of the hospital.

It is a common belief, in fact, that the hospital is somehow similar to a labyrinth, due to its endless corridors, often identical. Wayfinding problems impact not only on patients, but everybody experiences the place, i.e. the relatives and the medical staff, forced to interrupt their mansions for helping the users to find their way. Users are scared to get lost, to not find anymore the way to come back and, for that reason, they not completely enjoy whole the services offered by the structure. These problematic in the long run become, not only a relevant source of stress, but also a cost for the health company.

Differently from other hospitals, patients of pediatric hospital experience a continuous evolution and this make harder identifying precisely all possible source of stress. For this reason, is necessary looking the space with the perspective of the children, because what may appear beautiful or enjoyable for an adult, may look boring or even anxiogenic for children.

The child has a limited emotional experience to face the challenge resulting from hospitalization and, for this reason, he/she may be more vulnerable respect to different sources of stress.

### 1.4 Pediatrician's Point of View

The design and architecture of spaces dedicated to pediatric ward may have a relevant psychological impact on children and their family.

Design and architecture may improve the permanence of patients and their relatives in the hospital and, at the same time, they may have a positive impact on the activities of whole the medical staff. The latter face a stress often higher than other due to emotional implication respect to their young patients.

The child should first enter in a comfortable, lovely, relaxing and colorful place which evokes protection and peacefulness.

A child-friendly environment that arouses family like feelings, esthetically tidy and enjoyable, contributes to the rehabilitation and wellness, which also may result in a shorter permanence of the patient. All of that would lead benefit, not only to the children, but also to whole the relatives that face up the hospitalization with them.

## 2 The Aim of the Research

The aim of the present research is to propose an innovative approach in the designing for kids discipline by individuating a series of good practices for the strategic design of communication and way-finding systems to be applied in indoor spaces dedicated to children and, in particular, in several areas within pediatric hospitals. In order to improve the well-being of children and make them feel comfortable in indoor public spaces and, in particular, in the pediatric hospital interiors, it is necessary to render those spaces more friendly.

These good practices have to guide designers to design interior way-finding systems able to orient, inform, interact, entertain include all kind of children, at different ages, using one universal language of their collective imaginary. In order to improve this new design culture, the purpose of this work is to recommend a methodological referring system to be easy applied in different indoor places dedicated to children.

The suggested good practices are designed taking into account the peculiarities (skills, abilities, behaviors) of children at the different ages groups in accordance to the theory above mentioned. In other words, the purpose of this work is to propose a referring methodological system to design way-finding systems in indoor collective spaces able to communicate with all kind of children according to two different modes of interaction.

The first communication mode is designed to orientate children guiding them along interiors without losing their way and informing them about surrounding areas and services. It is based on simplified orientation and secure informative messages. These kinds of systems are usually founded on children behavior so that children use their previous experiences to find their way.

The second one stimulates the emotional sphere of children and allows them to live pleasant experience in an unknown place. It concerns the connotative meaning of signs able to entertain and reassure, suggesting familiar routine and known practices belonging to their imaginary. This kind of communication is based on the knowing of children' imaginary belonging to the experiences of their life.

Summarizing the final research's aim is to find open rules and good practices for the design of way-finding systems able to orient, to reduce stress and feel at ease a large number of children in unknown indoor collective spaces.

These goals also allow communicating with children as main users and indirectly with parents and health staff according to different levels of interactions.

## 3 Methods of Research

### 3.1 "Children Centered-Design": Multidisciplinary Approach

Way-finding systems have the function to advice or remind people about the surroundings, presenting the information at strategic points to orient and inform them. Children have a different ability of orientation in comparison with the adults and for this reason it is necessary to study their skills and behaviors at the different ages before start designing for them. Consequently, it is necessary to define a design method for way-finding systems based on and strongly taking into account the natural skills, behaviors and inclinations of children. In this way it is possible to design a system really able to guide and entertain children in a pleasant way using strategic solutions.

The methodological approach to design communication and way-finding systems in collective interiors and in particular in pediatric hospitals refers to the human centered design rules in order to inform the little users about surroundings and giving them points of view and references for finding their way in autonomy as in a familiar place.

The present work uses a multi-disciplinary and holistic approach involving different disciplines essential to study the children as main users. As a matter of fact, from the birth to adult age, young people have a continuous development of physical and psychical abilities, which are necessary to know in order to design according to children centered design approach.

The involved disciplines are mainly pedagogy, cognitive psychology and pediatrics. The contributions of each discipline represent the indispensable basic knowledge necessary to summarize all the features in the final design proposal.

Starting from pedagogy, the research refers to the educational theories of Montessori, [25] and of Loris Malaguzzi [22] whose educational theory is known as Reggio Children approach. These two Italian pedagogical theories are ones of the most followed in the world. Among their various indications, they identify the environment where children live as an essential support for the growth and development of them, to enhance their potential, resources and many intelligences. [8] Consequently, it is very important that the environments where children live - from a domestic interior to a hospital - are designed taking into account the pedagogical theories mentioned above. Consequently, the designer can use all the information to design way-finding systems for pleasant and inclusive experiences. The children's indoor environment characterized by ad hoc "elements", colors and graphics play a fundamental role, determining a scenario such as to be perceived by the child as friendly, pleasant, safe and familiar, do not allowing them, to lose their way. The scholars also identified three age groups of reference, 0–3, 3–6 and 7–11 years old. These groups are indicative of the steps of growth and related skills and abilities, as also explained in the cognitive psychology theories by Piaget [29] in the Sixties. Moreover, Piaget highlighted the importance of playing for children. It is sure enough that when children play they show their needs to communicate their own emotions. Certainly, the designers will have to take into account this information when designing for kids. Environments and products able to induce behaviors focus on the emotional aspects that, as Norman says, [27] they are the engines of psycho-physical development and learning.

The technique of playing represents a solution for the designer able to realize this contact with the little user. When children play they underline their needs to communicate and socialize and, at the same time, show their inner emotional world. In designing, it is *modus operandi* the involvement of the main and secondary users in co-working activities at the early stages of job definition.

The strategy of involving small users in co-working is necessary for highlighting the relations between the type of actions and the emotions happening in an experience inside unknown spaces.

In general, this is an important activity because it is able to make designers think in an innovative way. The co-working approach has been experimented as described below during the development of the present work.

## 4 Applied Method. Use Case: Pediatric Hospital in Sassari Italy

The research described in this paper investigated the following aspects, by relating them with the specific scenarios of the Pediatric Hospital at Sassari:

- Study of the literature: perception psychology, pedagogy, pediatrics, children skills and behavior at different ages, way-finding systems, children design, communication design, human factor design.
- Direct observation of children in connective and waiting areas of pediatric hospitals (as guests and as patient) - as explained in the use case below.
- Interviews to medical, health staff and parents for detecting problems of orientation both for them and for kids in collective areas of pediatric hospital.
- Co-working activity with children aged 7 to 12 years.
- Collection and comparison of results.

This practical activity with the children was based on the detection of their mood and needs when they are in the hospitals as guests or as patient.

The purpose of this co-working activity is also to know if and how children feel at ease and if they have difficult to orientate in public collective areas in hospitals. Moreover, the experimentation aim to identify possible real solutions interpreting children suggestions.

The results have the function to verify possible solutions and also to contribute to specify good practices to design a way-finding system able to guide little users, orienting and informing them with the use of the colors and familiar elements according to their own language and imaginary in a pediatric hospital.

Equally the method highlights the elements that are critical and do not let children feel at ease and live a pleasant experience.

### 4.1 Use Case

The experiment was set-up in Sassari (Italy), a small town in the north of Sardinia, at the St. Peter Pediatric University Hospital, which is the second most important pediatric clinic in the island and that, during summer, it becomes the point of reference also for tourists of the all northern coast.

The research has implemented three main actions which allowed to understand better children behaviors: direct observation, interviews and co-working initiatives together with children.

**First Activity Direct Observation.** It started considering the waiting areas in the ward, in emergency care units and the connection spaces among different clinics. The experimentation activities have involved children aged from about three to twelve years old visiting the hospital. Children were belonging to different nationalities. The observation showed how all the children were interacting with hospital environment and interior settings and how they were moving in the surrounding environment with and without their parents.

The method's application points out, for the most, the difficulties of all the children to be oriented and feel comfortable. We discovered that the main activity that children of all ages have in common, is playing. Besides, the observation highlighted how children, inside these spaces, used to play mainly together with well known and familiar elements, even if they were not designed specifically for playing. The observation also underlined that children were attracted mainly by multimedia and interactive elements present in the areas, even if they are not addressed to them.

Moreover, we observed that the more common behaviors of kids were inspired by different kind of space elements such those, for instance, floor's tiles inspiring the game "the floor is lava" or grouts spacing of flooring which inspire balances games.

**Second Activity Interviews.** In a second moment, frontal and questionnaire interviews were conducted both by the medical, paramedical and technical staff, and by visitors and patients' relatives to the structure. The questions asked to visitors required an evaluation of the interior hospital's and way-finding system. The results of the interviews showed that visitors found the internal signage very poor and causing a lot of difficulties in orientation within the hospital. The interviews' answers underlined that, very often, visitors were used to ask the staff the best path to reach their destination. Moreover the questions asked to the hospital's staff required an evaluation of the interior hospital's signage and wayfinding system.

The results of the interviews con-firmed that very often the hospital's staff is distracted by visitors asking information, which is usually cause of stress. This habit suggests the necessity of improving the communication and wayfinding system.

**Third Activity Co-working with Children.** The third action of co-working with children was carried out thanks to the collaboration with six schools in the city of Sassari. The workshops involved children aged 7 to 12 years. This activity, referring to the studies carried out by Filippazzi on the need for a group "vaccination" [9] to be implemented in schools to ensure that children could live better the experience inside

the hospital, allowed to make the hospital known outside the hospital building, involving children and making this place more familiar to them.

During laboratories carried out in co-working, children, followed by pediatricians, pedagogues and designers, drew a series of characters that they would like to see inside a hospital, and that could "make them feel better".

The co-working allowed the researchers to highlight the thoughts, the emotions and the imaginary of the children related to the hospital environment.

## 5 Results of the Research

### 5.1 Good Practices

The present work states that collective and connective spaces, in pediatric hospitals, have to be characterized by specific way-finding systems and signs/elements designed ad hoc. These ones have to facilitate orientation and relations, to stimulate interaction and imagination and encouraging the socialization and the playing for well-being of children.

As a result, the research proposes a series of good practices, which are easily applicable to different kind of pediatric hospital interiors, both for new hospitals and for existing ones. The following steps describe the actions useful to design way-finding systems.

What is necessary to individuate:

- Collective areas (i.e., waiting room, bathroom, restaurant, play room, library, etc.) that needed to be reached by children.
- Corridors and connective spaces that are necessary to walk to go from one area to another.
- Each existing element (i.e. doors, baseboard, windows, switchboard, signage, etc.) in the above spaces, which could be necessary to re-design or taking into account for the way-finding design. This point is valid only for existing hospitals.

What is necessary to define:

- The optimized ways for easy orientation.
- All the elements (material and/or graphic) specifying the colors to be used, the shapes and the illustration according to the imaginary of children, able to improve children's perception of indoor spaces. All of these elements are designed as a "family of sign types" [10] placed in a recurrent mode along the way, according to the rules previously defined. Following this indication, it is suggested to design a coordinated image manual describing exactly the rules of the system.

What is necessary to determinate. The strategic communicative functions of each "element" used to design the way-finding systems, in particular between:

- Basic function: able to orient and to inform about the surroundings, realized by visual communication on the floor and on the walls positioned at a height not exceeding one meter and half (related to children height to be easy visible by them).

- "Emotional" function, with connotative meaning: able to reassure, engaging the senses, and entertain, realized through familiar elements and the practice of playing, remembering pleasant situations and actions of their daily life.

The connotative functions include many messages differently understood by children in relation to their ages, their cultural baggage and their knowledge. Generally, they refer to "elements" of children's imaginary. They could be iconic inspired by natural elements as animals, flowers, etc. or coming from tales, games, video games, cartoons, etc.

### 5.2 Results

Another very important practice that characterized children life is the playing as underline also Piaget [29].

It is quite sure that when kids play they show their own emotions together with their desire of communicate.

As a result of the observation of children at hospital and of the co-working activity (as described above) it is important to underline the importance on playing both in traditional way, - as for example symbolic or vertigo games - than in virtual one, as video games and app used by children, which are digital natives, with satisfaction and easiness. All the communicative elements of the way-finding system should stay on the following features:

- To be ludic: graphic or material elements suggesting or remembering familiar games-usually acted at home, at school or at playground. As an alternative, interactive elements offering familiar tools like video games to be used only in common waiting areas to entertain.
- To be defined by specific colors and simple shapes: easy to identify and recognize inside an interior, also encouraging creativity in differently aged children.
- To be sensory interactive: stimulating curiosity and pleasant emotions, and at the same time, feeling children well and at ease.

## 6 Conclusions

In this paper we have identified a set of design principles and good practices to define the hospital spaces through wayfinding systems design according children needs with the final aim to improve children hospital experience. The result of the present work highlights that collective spaces for children, as pediatric hospitals, need new wayfinding and communication systems designed ad hoc in order to render the interiors familiar for the little users feeling them at ease. Besides, the research claims that familiar elements (both material and graphic) are responsible of pleasant experience influencing the well-being of children and consequently facilitating the disappearance of stress and a speedy recovery.

Basically, children need emotional way-finding systems designed using natural stylized elements to live experiences in security and in freedom.

We hope to share the result of the present work in order to apply and to develop the proposed open rules for designing more and more hospital's interiors children-centered in the next future.

## Appendix

Author Laura Giraldi has coordinated the overall writing process of the paper and has written the following sections: 1.1 "Wayfindind Systems", 2 "The Aim of the Research", 3 "Methods of Research", 4 "Applied Method. Use Case: Pediatric Hospital in Sassary (Italy)", 5 "Results of the Research", 6 "Conclusions".

Author Marta Maini has written the following sections: 1.2 "Pediatric Hospital", 1.3 "Children and Parents' Stress in Pediatric Hospital", 4.1 "Use Case".

Author Donatella Meloni has written the following sections: 1.4 "Pediatrician's Point of View".

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