Sources of inspiration: a language of design

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Sources of inspiration play an important role in the design process, both in defining the context for new designs and in informing the creation of individual designs. Previous designs and other sources of ideas furnish a vocabulary both for thinking about new designs and for describing designs to others. In a study of knitwear design, a process in which the use of sources of inspiration is explicitly acknowledged, we have observed that designers communicate with each other about new designs, styles and moods, largely by reference to the sources of their ideas. In this paper we discuss why this style of communication is so important, and what information it is used to convey. We view it as the use of a language to describe regions in the space of possible designs.

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The Enterprise–D encounters a starship crewed by an alien race with whom Captain Picard and company cannot communicate despite the omnipotence of their universal translator1. Eventually they discover that this race communicates entirely by reference to historical anecdotes or shared myths. The Tamarians can express in a few words a complex concept like ‘two strangers overcome their differences in the face of great peril and are friends ever after’, while conjuring up a rich picture of the emotions involved in the adventure. However it takes them equally long to convey a simple concept such as ‘give me a knife’, by referring to a story of a man who opened his arms in front of a town wall and was given something.

In an ethnographic study of the knitwear design process we have observed an almost equal reliance on shared cultural references to express design
Knitwear designers talking among themselves describe designs almost exclusively in terms of combinations and modifications of design elements that they refer to either by category labels or by their origins—in other designs, or in other objects or images. Their words can only be understood correctly by people who know what the sources of their design ideas are. Often the referents of the designers’ descriptions are nowhere to be seen, but are simply part of the designers’ shared cultural experience. While the sketches they create to communicate designs are intended to be context-independent, the recipients’ interpretations depend on their understanding of categories of design elements. Knitwear designers’ communication of their designs shares many characteristics of the Tamarian language: complex concepts can be expressed concisely by reference to sources of inspiration, but many simple things cannot be made explicit. We have also observed very similar communication by reference in a study of helicopter design, a branch of engineering with interesting similarities to knitting.

This paper seeks to describe and explain this phenomenon. Why is communication by reference to examples so pervasive in knitwear design? What can and cannot be said in a language of examples? When is it an effective means of communicating designs? What happens when people don’t share the same stock of reference points?

1 Sources of inspiration

Almost all design proceeds by transforming, combining and adapting elements of previous designs, as well as elements and aspects of other objects, images and phenomena. Everything can be a source of inspiration to a designer. ‘A good designer is inspired by everything’ is a frequent quote one hears from knitwear designers as an answer to the question what makes a creative designer. Designers use a variety of types of source: comparable designs (for knitwear designers, other knitted garments); other types of design (for knitwear designers, typically textiles and other decorative products); images and works of art; and objects and phenomena from nature and everyday life (such as the rhubarb leaves that lead Ove Arup to the design for the Kingsgate footbridge in Durham, England). Real physically present objects reveal more details and carry information about manufacturing processes; while images of objects already have some interpretation attached to them in the way they have been created, for example in the light in which objects are depicted, or the context created by the objects or people with whom they are displayed.

We use the term source of inspiration for all conscious uses of previous designs and other objects and images in a design process. It subsumes...
narrower terms for specific uses of idea sources in design: starting design—the design that is modified to generate a new design; precedent—in architecture a culturally approved building that lends authority to new designs based on it; reuse—the deployment of an existing component in a new context; pattern—the manifestation of a solution principle; and primary generator—a salient and explicit feature of the problem which shapes the design. Sources of inspiration play a number of important roles in design thinking, as definitions of context, triggers for idea generation, and as anchors for structuring designers’ mental representations of designs.

2 Knitwear design: a case study

Our empirical study of the knitwear industry, carried out over seven years in more than 25 companies in Britain, Germany and Italy, has focused on (1) communication in design teams and how this can be facilitated by computer support; and (2) the use of sources of inspiration throughout the knitwear design process. While it is simple enough to be understood, knitwear design shares many characteristics of complex engineering projects; many ubiquitous phenomena are especially salient and clearcut in knitwear design. Complexity arises from the interactions between the inherent limitations of knitted structures, material properties, manufacturing constraints, market pressures and aesthetic considerations. Knitwear is created by multidisciplinary teams, and problems arise from failures of communication between team members. The product is highly dependent on the context created by other designs and cultural and technological developments.

The role of sources of inspiration is recognized and openly acknowledged in the knitwear industry, where they have two fundamentally different but connected functions. (1) They define the context in which new designs are created. By looking at garments and other sources of inspiration, and learning what their competitors are doing, designers define the regions of design space into which their own designs should fit. The challenge is to select fashions, and locations within the envelope of each fashion, that fit their customers’ self-images, or to create distinctive products by stretching the envelope without breaking out of it (and thus appearing odd or tasteless)—see Figure 1. Fashion as we see it in shops emerges through many designers using the same objects as inspirations according to forecast trends and the lead given by catwalk designers. (2) Sources of inspiration inform the creation of individual new designs, which are adapted from one or more sources of inspiration. Designers employ a number of adaptation strategies, in which the synthesis of a new design is either triggered by the source, or the designers select a source based on a plan for their design.
The roles of sources of inspiration in design cognition

Perception of external sources of inspiration prompts new imaginings. Research on the role of externalisations in design thinking has concentrated on the role of sketching. Schön has shown that for many architects, sketching is an essential part of creative design, and creation is driven by making and perceiving sketches; Schön characterises design as an interactive conversation between mind and sketch. Designers directly appreciate different types of information in their own sketches, alternating between seeing that and seeing as. Ambiguity in sketches facilitates reinterpretation triggered by dissatisfaction with the current design. For designers who make active use of sources of inspiration in designing, they play a similar role to designers’ own sketches. The sources most typically used by knitwear designers are images of other designs, which seldom have the vagueness and ambiguity important for triggering reinterpretations. However adaptations are triggered by mismatches between visible or imagined design elements, and between designs and goals. Previous designs are not the only source of reusable chunks. Knitwear designers actively search for sources of shapes, patterns, motifs and colour combinations that can be translated into aspects of designs.

Skilled designers in visuospatial fields, notably knitwear, are usually very good at generating rich and detailed mental images of designs, and have very strong visual memories. They typically have the subjective experience of perceiving complete pictures, though aspects or details may change or only appear when people concentrate on them. Research on mental imagery shows that mental images and spatial representations are not bitmaps: they comprise organised structures of meaningful information: chunks. How well they are remembered depends on how meaningful the information is and on how richly it is structured. Strong visualisers create and recall very complex visuospatial chunks. Recognising similarities is an inherent part of visual perception, and people group similar objects into categories. The visuospatial structures of individual items are encoded not
just geometrically but in terms of category memberships and deviations from typical forms. Knitwear designers look at very large numbers of garments and images of garments in the course of design research, and can remember them. Designers develop both a stock of categories of designs and design elements with typical forms and ranges of variations, and a stock of instances they can remember and refer to by where they came from. These provide a vocabulary for their mental representations of new designs. Individual designs provide a large and open-ended range of subtly differentiated concepts, accessible in memory but with no names other than references to their origins. Strong visualisers, including many architects and engineers, often imagine new designs in considerable concrete detail, often much more detail than they need for some conceptual design activities. Knitwear designers report thinking about quite concrete designs during range planning, which they know are placeholders for categories of garments to be designed later. Our observational evidence indicates that they frequently draw design elements from their rich and open-ended stock of instances rather than design element categories, so that what they imagine are variations of concrete designs rather than elaborations of abstractions.

Previous designs comprise coherent combinations of design decisions: design elements and their interrelationships. Complex designs comprise far more information than any designer can think about at once, but designers’ stocks of remembered previous designs and other sources of inspiration enable them to use these combinations to imagine and reason about complex structures, by treating pre-existing chunks of information as units. Complex designs can be represented concisely in consciousness and memory as combinations and modifications of existing chunks. Such designs inherit the structure and details of their sources, so that small and simple sets of sources and modifications generate complexly structured designs, whose details are imported into consciousness as part of larger chunks, or can be generated at need. Some aspects and implications of these complex forms do not need to be explicitly created or remembered; instead they can be reconstructed from the original chunks. Thus designs comprising simple modifications and combinations of pre-existing elements that can be remembered are easier to imagine than more complex or radical transformations.

4 Communicating through sources of inspiration
Designers communicate by reference to previous instances of design elements in a variety of different situations, to achieve different objectives. The extent to which they rely on verbal references rather than showing actual images or objects is influenced both by how much of their cultural context is shared by their conversation partners, and by how much effort they want to invest in the communication.
Most communication by reference to example by knitwear designers is about the emergent visuospatial form of their designs. Different visuospatial aspects of designs can be indicated separately by referring to different sources each quite different from the intended design; for instance a knitwear designer might indicate a colour scheme with a photograph of waves lapping on a sandy beach. A very important part of design communication about consumer products, not just in advertising but within the design process, is cultural connotations of the design. In knitwear design images unconnected to the garments themselves are used to convey ‘mood’, the desired self-image of the intended wearer, and the positive values, experiences and feelings the product should be associated with. In knitwear design the communication of visuospatial and cultural aspects of designs is often not clearly separated. Of course, functional and structural aspects of designs dominate design thinking in many industries. But they were seldom referred to by the knitwear designers we studied, who leave structural complexities to their technicians, while function is implicit in the overall category of garment. Structural aspects of designs are implied consequences of the selection of design elements on aesthetic criteria.

4.1 Classes of concepts communicated through sources of inspiration

In aesthetic design domains we can differentiate between three different types of information that is communicated primarily through images or references to images.

4.1.1 Individual designs

New designs are often expressed by showing or referring to sources of inspiration and indicating how they should be combined and modified. In the knitwear industry ranges of designs to be sold together are often displayed by grouping sketches and pictures of source material on boards. Individual worked out designs are normally communicated in sketches. Design discussions customarily describe modifications to existing designs or other sources of inspirations; and are usually supplemented by sketches. Knitwear designers hardly ever sketch during design discussions.

4.1.2 Styles

Categories of designs are often described by showing groups of images that illustrate the range of designs that belong within the category (see Figure 2). Such image clusters are an important feature of fashion trend magazines such as Zoom on fashion trends and Book Moda (better known to designers simply as Collezioni). What makes the images similar may not be obvious and may not be explained. Often one or two images are highlighted, for example by making them bigger, because they either show extremes within the space or provide typical examples.
4.1.3 Moods

Images are used to set an overall ‘mood’. *Mood boards* play an important role in design communication in the knitwear and fashion industries. These constitute descriptions of the overall aesthetic impression the items in a category should create. This can include colours, proportions, cultural connotations and so on (see Figure 3). Mood boards are often arranged around one central image which encapsulates the essence of that mood, with others that indicate the scope for interpretations. Some images are included purely for their visual properties, others for their cultural properties. Some have

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*Figure 2 A style display* (Zoom on Fashion Trends, year 5 number 8, 1998, p 50)
both. The mood is an emergent consequence of the combination of displayed images and inherits much of its connotation from them. The text accompanying Figure 3 is ‘The bright colours by Lyocell [fibres] look back to the atmosphere of far away places, back to exotic smells and oriental beauty as they appear in the ‘Sensuous’ theme with flower, arabesque and enjoyable striped patterns’. The tiles are medieval European and Turkish, the fruit painting European, the intended overall effect Indian or southeast Asian. Mood boards serve to indicate a range of possibilities; their power is perhaps best understood by seeing what they exclude; for instance blues and greens and pictures of waves do not go with chunky russet red sweaters. Moods can also be communicated verbally by reference to a sequence of objects.

In communication within the knitwear design process, moods and styles are normally expressed on boards. All the information is shown concurrently, in contrast to the sequential nature of verbal descriptions. Individual designs can either be presented on boards or by showing a sequence of
images. The distinction between individual designs, styles and moods can be blurred in industrial practice.

### 4.2 Shared cultural context

During the research and conceptual design of garments for a new season, designers often talk to each other about their design ideas. To an outsider these conversations appear entirely cryptic, for example: ‘I want to do a cardigan like the one in Vogue, but in pink mohair’ or ‘let’s do a jumper like the blue one last year, but a bit longer and with a V-neck’. This has very little meaning unless the listener has seen the relevant design, can interpret the changes, and can visualise the product (Which pink? Which mohair yarn? How much longer? How deep is the V-neck?). Even if all parties can have the physical objects or pictures of them in front of them, they still have to imagine the changes.

Knitwear designers understand each other, because they have seen the same garments in shops and read the same magazines. Designers in the same company share a knowledge of the company’s house style and have looked at the same research material. They share the same body of sources of inspiration defining the context of the fashion. Even if the individual instances that they generalise from are different, the emergent picture is the same. Each season in fashion or style or domain creates its own interpretation of words in everyday language. For example ‘blue’ or ‘a bit longer’ has a different meaning for 1999 than for 1996. Understanding such cryptic remarks also requires specific knowledge about the speaker. Designers know what their colleagues like and what they have been working on, as well as the house style of the company. So they can guess which cardigan the speaker might have picked up on. The listener includes all this information when visualising the design the speaker describes.

### 4.3 The relationship between visual and verbal description

Early conceptual designs are communicated through pointers to existing sources of inspiration and modifications to them. The modifications are expressed verbally. The descriptions are often vague and require interpretation. For example when geometrical dimensions are modified, the changes are often explained qualitatively, like ‘a bit longer’ or ‘much deeper’. Sometimes numerical values are guessed, giving the appearance of accuracy when they are just placeholders for rough magnitudes.

Many design domains, such as knitwear design, do not have a universal standard vocabulary for variations of design elements, such as cables or lace patterns. New structures are invented all the time, without a corre-
sponding increase in the range of meaningful names for them. Therefore only a direct reference to an example can communicate the design element unambiguously. The same problem applies to colours: a huge number of colours are perceptually distinguishable, but human languages have only a small range of accepted colour names. (There are standard naming and numbering conventions used by colour scientists and other professionals, but the names used for marketing purposes by paint and yarn manufacturers are contradictory). Some knitwear and fashion companies benefit greatly from developing an internal vocabulary for design elements and colours. In other domains, such as mechanical or electrical engineering, components are given precise identifiers, either referring to exactly defined categories or to the catalogue numbers of parts. It is inherent in the structural properties of knitted fabric that no complete and accurate description of a knitted garment is possible, and formal descriptions in absolute terms are difficult to use effectively: this has profound effects on the communication of designs between knitwear designers and technicians. So designers make do with informal vocabulary that is open to misinterpretation\textsuperscript{2,3}. Reference to examples is more concise and precise than alternative descriptions.

Words can be used like images to evoke the connotations of designs and styles rather than describe them. Clusters of images in fashion trend magazines are frequently accompanied by prose descriptions that can seem ridiculous or preposterously pretentious, but which are primarily intended to be suggestive. For instance, the text in Figure 2 begins ‘The triumph of essential styles under the profile of understatement and influenced by New Age philosophy. Clear geometric, minimalist lines are emphasised by straight skirts, monochrome suits in neutral or grey colours.’

5 \textbf{The structure of the language}
Sources of inspiration provide designers with a vocabulary for thinking about designs and communicating their ideas to others. In this section we push the linguistic analogy a little further, to explore the structure and expressive power of source-based communication.

5.1 \textbf{The syntax}
Descriptions of designs in source-language typically comprise references to objects and images, sometimes to abstractions such as moods like ‘playful’ or cultures like ‘Arabic’, plus phrases describing how they are modified and combined in the new design. The sources themselves have the character of \textit{nouns}, while the modifications have the character of \textit{adjectives}. These modifications can change any describable characteristic of the source. In knitwear design they might include shapes, sizes, proportions, arrangements, colour schemes and materials. Modifications might add,
remove or substitute components of designs, perhaps drawn from other sources. For instance, a designer might say (with reference to the large image in Figure 2) ‘produce a trouser suit like that but make the top a bit longer to cover the hips and use the blue fabric we used for last year’s trouser suit.’ The range of available nouns is large and open-ended, while the range of adjectives is comparatively small.

If source-language has nouns and adjectives, does it have verbs? The analogy to a verb would be a description of an action, to create a design or do something with it. In our observations of knitwear designers, they used source-language to describe intended designs rather than procedures for generating them, which are unspecified or implicit. In other words, they describe static locations in design space, rather than trajectories through it. Their use of source-language contained no verbs. However this is a consequence of the fact that although knitwear designers use active strategies for creating designs, they do not use any wide range of consciously articulated techniques.

5.2 The semantics

Verbal and visual communication in source-language defines locations within the space of all the possible designs of a type of artefact. The locations of individual designs are defined through a single set of complementary source-features. The hearer or reader recreates the design from the description, so communication depends on the hearer sharing the speaker’s mapping of terms to meanings. Communicating styles through pictorial displays of a range of instances is an important feature of fashion trend publications such as Book Moda, and is a frequent strategy within the design process. In the terminology of machine learning, the viewer learns the region in design space by generalising from positive instances. Negative instances are only implicit in the viewer’s prior experience. The region is expressed by examples that may be typical examples, or encapsulations of the essential characteristics of the region, or extreme examples (which are not explicitly distinguished).

Figure 4 illustrates how an instance of a class of designs influences the viewer’s perception of both the boundaries of the class and its centre of typicality—what the viewer thinks of as central or ordinary. This perception of category membership and the learning of category boundaries and centres is a tacit perceptual process. Moreover, people are ordinarily unable to describe such a region of design space even if they can point to where it begins and ends. This is because the defining characteristics of regions of design space in aesthetic visuospatial design and the dimensions on which they change are complex and subtle emergent properties: they can
often not be recognised, and if recognised, not described. Thus designers
often have no way to describe or even think about designs in terms of
compositions of fundamental terms and parameters. If such descriptions
are possible they are likely to be too unwieldy to use. So designers can
only refer to variations of instances or classes of designs embodying the
complex and ill-defined characteristics they can recognise but not define.

By referring to sources of inspiration designers can convey concepts very
concisely: a key image or a mood board can express an elaborate set of
cultural references; and a brief description can express a complex design.
But it is not the design itself that is communicated, but information about
a range of alternative designs. The listener mentally redesigns the design,
influenced by a different set of preferences and procedures.

6 Discourse in source-language
Conceiving and communicating designs by reference to sources of inspi-
ration arises in situations with particular characteristics shared by design
activities in a variety of industries. It influences the forms of explanation
and argumentation used by designers, and the ways in which the members
of design teams alter each others’ design ideas.

6.1 Communication scenarios
Designers’ communication in source-language works differently for differ-
ent types of recipient who have different amounts of knowledge of the
designers’ sources.

6.1.1 Oneself
Sources of inspiration function similarly to sketches, as (1) facilitators of
reinterpretation when the context has changed, and (2) as memory aids.
6.1.2 Fellow specialists
Designers exchange ideas with people who share similar knowledge, expertise and frames of reference. References to sources of inspiration provide powerful, effective and efficient means of communication when exactness is not required.

6.1.3 Complementary colleagues
The work of design teams depends on communicating designs to colleagues who have different concerns, expertise, mental representations of the designs, and frames of reference, but who share the same objectives. Unless accurate and unambiguous communication methods are available, such as precise technical specifications, design ideas are interpreted using contextual knowledge. Therefore it is important to share the sources, which act as referents. In knitwear design, designers’ verbal category labels are often interpreted by technicians in terms of their companies’ designs of previous seasons, rather than the designers’ sources within the design space of the current fashion, which leads to manufactured garments being more conservative than their designers intended.

6.1.4 Superiors
In fields like knitwear design, where managers don’t share the designers’ training or understanding of design, they have great difficulty following explanations based on sources of inspiration, and designers are often forced to produce rationalisations of their design choices that have little to do with how or why they have produced particular designs.

6.1.5 Customers
Designers need to present their designs and often also their ideas in progress to their customers, who differ enormously in knowledge and sophistication between and within industries. In the case of the British knitwear industry the customers are primarily the buyers for large retail chains. They usually understand fashion and the role of sources of inspiration, but know little about how garments are designed and manufactured. They obtain a coordinated collection from different suppliers by enforcing a common context through shared sources of inspiration. They cannot visualise new designs from sources as well as can practicing designers, and therefore insist on swatches and samples.

6.1.6 Unknown
Sometimes designers have to communicate their ideas when they can make no assumptions about what their audience knows or understands. A lay person has little chance to understand a discourse based on sources of inspiration, because they are familiar neither with the sources nor the modi-
fication rules. However they might be able to understand what would not be included in a region of design space indicated by examples or a mood board.

6.2 Argumentation in source-language
Because source-language refers only to locations in the space of possible designs, it provides designers with little ability to create or express arguments or explanations or justifications. Of course humans can argue with the full power of natural language, while Tamarians can resort to other stories to contradict, differentiate, or justify. But in knitwear design, reasons for selecting some sources rather than others are unstated, and procedures for mapping sources to designs are implicit, for the viewer or hearer to reconstruct from a shared understanding of the context. In both knitwear design and helicopter design, source-language is used when the concepts are too distant from objectively grounded terms to allow arguing with reference to an objective description of the design. What is possible are assertions about the characteristics that are imported from the sources, and where the modifications place the new design in design space relative to the sources. When the recipients are unable to reconstruct the new design from a shared context, or understand its implications, the only way to judge it is by the originators’ authority and confidence. In the fashion industry designers often have problems because they cannot justify their designs to non-designers such as managers or sometimes buyers, in rational terms that somebody who does not share the same design context can understand. But the justification for a garment design is its relationship to the space of garments admissible within the envelope of future fashion. As this is typically impossible to express in base terms grounded in everyday experience, it can only be understood by absorbing instances of designs and their surrounding mood indicators. To paraphrase Duke Ellington, if you have to be told, you’re never going to know. In industry, knitwear designers substitute assertions of the strength of their subjective belief in a design for rational argumentation; they are criticised for not asserting strong enough belief rather than for not presenting a coherent enough justification.

6.3 Aesthetics and complexity: sweaters and helicopters
We have observed very similar communication by reference to sources of ideas in a field study of customisation processes in helicopter design at GKN Westland, consisting of interviews with 23 senior designers. Helicopters are among the most complex engineering products and have exceptionally complex networks of interdependencies between subsystems and components. Although there are very few basic types, Westland helicopters are extensively customised for every customer. Very few people have an overview of the design process and nobody has a detailed understanding
of the entire aircraft. Helicopter engineers talk about their designs with reference to previous versions that have particular modification clusters to meet particular requirements, describing how they might be further modified. A description in terms of basic geometric and functional parameters would be too unwieldy to use in conceptual design, and make premature commitments to detailed decisions, when the characteristics designers need to think about are distantly removed from such terms. Each previous version is a complex but coherent combination of changes away from the basic design, whose behavioural characteristics are relatively well understood. As the designers responsible for different aspects of a helicopter don’t have a good overview of the product and don’t have experience in all aspects of the design, they cannot ground their explanations of behavioural characteristics in mutually understandable structural terms. Therefore the professional credibility and the strength of belief behind assertions gain an importance comparable to their importance in knitwear design.

In many respects knitwear design is far simpler than the design of complex engineering products. However, the visuospatial characteristics of garments that designers think about bear a comparably complex relationship to the parameters of their structural elements. Not only is the relationship between the appearance and structure of knitted fabric complex and poorly understood, but the relationships between visuospatial features and the design requirements also depend on the complex cultural context provided by other designs and their sources. Moreover, designers’ understanding of these relationships is tacit and perceptual. Our observations indicate that the effect of complexity is very similar to the effect of aesthetics in making the relationship between structural elements and the features and behaviour that emerge from their interaction subtle enough to force designers to resort to subjective judgement and argumentation, as well as example-driven thinking, when they need to think directly about interactions and emergent global features.

7 Conclusions
Communication of design ideas by reference to their sources of inspiration plays a major role in knitwear design. Individual designs are specified as changes to one or more sources. Groups of objects are used to express styles—regions in the space of possible designs. Interpreting such communication is fundamentally a redesign by the listener from the same starting point. It is thus reliant on the recipient sharing the sender’s knowledge of the sources and the cultural context.

Communication by reference to other designs and other sources of design elements is a powerful way to express complex ideas quickly, because the
new design inherits both details and context from the object of inspiration. Exemplars of designs and design elements also form the mental vocabulary that designers in the knitwear and fashion industries use to create new designs. Many characteristics of designs cannot easily be expressed in any absolute terms without reference to examples and variations from them. The language of design biases new designs towards existing ones, because the more a new design differs from the stock of old designs, the harder is it to imagine it or express it.

Communication by reference to previous designs and other sources is not limited to aesthetic design: it is a feature of situations like the conceptual design of helicopters, where designers think in terms of coherent feature clusters and emergent properties rather than individual parameters and structural elements.

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