

META-CONTENTS OF DESIGN CREATIVITY: EXTRACTION OF THE KEY CONCEPTS THAT FORM THE SENSE OF DESIGN

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Abstract: This study aims to detect the meta-contents of design creativity in modern society, which has shaped the development of such designed products. To identify the meta-contents of design creativity, we investigated cognitive features through design discourse using the qualitative analysis Based on the survey to define design cognition focusing on the mindset of humans by discourse analysis; we identified the cognitive features underlying creative design ideas, comparing those in designers and craft artisans, to identify both inner and social senses. Second, we discuss the meta-contents of design creativity characterized in industrial development by bridging the local meta-contents determined by the content analysis. The discussions in this work approached the nature of human creativity based on the investigation of the cognition and meta-contents of design creativity. The results could help deepen the creativity of design thinkers.

Keywords: *creativity, meta-contents, design discourse*

1. Introduction

1.1. Sense of design

A sense of design is a crucial point in considering the rationale of design, particularly creative design, which epitomizes the higher values of society and defines the direction for future generations (Csikszentmihalyi & Robinson 1990; Taura & Nagai 2013). Identifying the social sense in product design, or the factors that form the sense that influences values, is a key issue in the study of finding the meanings of design. A number of previous studies have targeted these factors, such as needs or requirements, including hidden ones (Brown 2009) as well as desires or wishes (Bloch 1995). The rationale of these factors, such as needs or requirements, must be discussed to determine the sense of design in the future. In terms of methodology to understand sense of design, heterogeneous information obtained from peoples' daily social activities must be applied. Information technology is expected to aid the analysis of social change and prediction of future tendencies; the term "big data" represents such a development of data-mining (Chen et al. 2012). Identifying opportunities through technology is key to inspiring designs. Advanced techniques for analyzing the meaning of the discourses are considered promising. Analytical tools that use big data from social network services are good examples. However, the targets of recent technology remains focused on filtering for processing, and a method for identifying the social sense that promote design is still unexplored. To

reach exploration of sense of design, a comprehensive investigation of obtained data on the meaning of design and commodity in past empirical studies must be accomplished as the first step to overcome the above limitation.

On the other aspect of sense of design, the assumption is that certain social norms, including morality or ethics, influence individuals to form a personal norm in their minds, namely, an inner sense. For example, knowledge of current fears about species extinction and predicted loss of ecological balance will lead to a higher level of awareness for the significance of sustainable design, which forms a motivation within individuals to design under the concept of “sustainability” as driven by their inner sense; this scenario particularly applies in development of product design (Taura & Nagai 2013). Further, caring for people tends to fuel motivation for creating designs that prioritize wellbeing, again driven by an inner sense of the norm of “empathy” to help people cope with disabilities through the creation of user-friendly interfaces. In short, the norms in society and those formed in the mind share a resonance relation. Thus, a sense of design, as a driving force, will inspire and lead the next generation of or creators, and consequently, future artifacts and environment. It is necessary to identify by extraction of social norms from social phenomena for exploring on this aspect. Compared with data-mining, a method of ethnographical discourse analysis is expected to be more helpful in the extraction of the inner sense of design in certain contexts.

Notably, the above view on the phenomena of sense driven development is different from previous understandings of the mechanisms of product development or product evolution based on marketing (Ulrich & Eppinger 2008); that explained in the realm outside human factors (feelings, sense, etc). This phenomenon should be clarified via discussion of design creativity to identify the meanings of design in the future, which will serve as a scheme of the environment of the next generation. Moreover, creators of design at social level (i.e. design thinkers) must be educated through the study of the meanings of design based on the resonance of the inner sense with society.

1.2. Design discourse

In studying the meanings of design, the meta-contents of designed products through the examination of the contents of “design discourse,” which is influenced by social norms, must be investigated. “Design discourse” is a scheme that is of interest in the research of semantics of design. A practice-based research approach has been developed to understand users’ experiences in design (Koskinen et al. 2011). As artifacts have become increasingly expressed using language, designed artifacts have been performing functions, as seen in “design as discourse” (Perez-Gomez 1999; Krippendorf 2006; Faust 2009; Junaidy et al. 2013). Further, designers’ experiences including creative thinking (i.e. design protocols) have been studied by a self-observing method for approaching the inner sense (Nagai et al. 2010).

Aiming at the inner sense of design creation, this study targets the influences of meta-contents on the design ideas among the contents that form design discourse. The generated design ideas are from users’ or designers’ cognitions of the interaction between humans and products, which are selected because they are influenced by the cognitive levels of design that represent the essential parts of human creativity. This study intends to identify the meta-contents of the integral paradigm of design, which bridges design discourse contents in different domains. Basic to the understanding of studying discourse and meta-contents is the extraction of essential norms among heterogeneous contents obtained from narrative information. The contents of design, which form design discourse, include various kinds of information provided to or experiences obtained by users. Meanwhile, the “meta-contents” of design discourse express the essential values of design (namely, design sense); which are extracted from a network of the associated contents of design as knowledge representation. Content analysis is popular method for examining communication to extract keywords or sentences that suggest the core meaning of a text. For example, critical discourse analysis is a type of content analysis that considers language as a form of social practice and then extracts the social and political tendencies of a text (Fairclough 1992). The extracted keywords or sentences are assumed to represent the meta-contents of the core contents. Using the same research framework as the above, content analysis, integrated with discourse analysis, is applied in this study to shed light on the inner sense of design by extraction from design discourse.

1.3. Aim and methods of this study

This study aims to identify the essential norms or meanings of design within peoples' inner sense. Hence, this work will detect the integral meta-contents synthesized by the different local meta-contents extracted from the design discourse during creative practice as well as experiments observing cognitive features.

A method of this study is the investigation of the contents that form the design discourse. Discourses are analyzed to extract the meta-contents, which reflect the rationale of the design discourse, via content analysis. Surveys and practice based experimental studies are likewise utilized to gather data on design discourses. Figure 1 shows a structure of the layers of content analysis of design. Design discourse covers the words expressed by humans and the contents represented in the words or texts. Underlying this layer, human cognition is represented via associations, and in-depth cognition can be detected from the structure of associations. The core parts comprise the meta-contents, which represent the rationale of cognitive features and show the essential meaning of design. Throughout those layers, design sense that sparks design creativity and deepens design thinking, will be discussed.

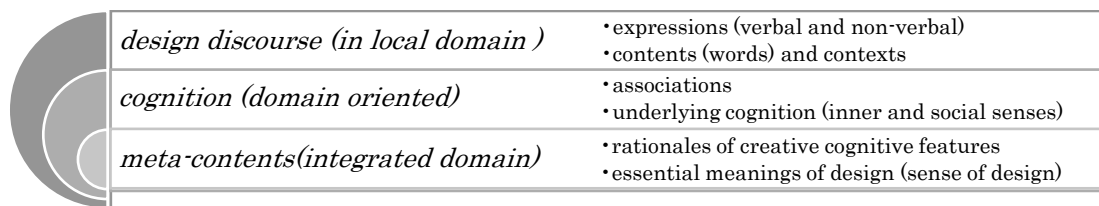


Figure 1. Structure of the layers of design discourse, cognition, and meta-contents

2. Content analysis in design discourse

A method of content analysis in design discourse was formed through the observation from 2011 to 2012. It was planned to observe the cognitive tendency of a mental model, namely mindset, during interaction between humans and device interfaces (Georgiev et al. 2012). We surveyed the discourse which represent contents of interface design underlying cognitive features that relate to inner sense. The types of device interfaces were categorized with consideration for touch-based human interaction. The experiment was set in a car, and human actions for the usage of three devices were compared: navigation, air conditioning, and audio player. To analyze the cognitive process during interaction, each activity and verbalized protocol was observed. We used video monitoring, think-aloud methods, and questionnaires. The observation was carried out in 2012, after a pilot study in 2011. Conditions of the survey were as follows.

- Participants: 60 adults (balanced conditions, i.e., gender, age, and handedness)
- Situation: in a car (two types of devices: knob, remote control)
- Methods (video monitoring, voice recording, think-aloud methods, one-on-one interviews, questionnaire for semantic differential method analysis)

Immediately after the experience of device use, the subjects were asked to answer the questionnaire, which was based on the semantic differential method, and then comment about the interface design. The evaluation items had three categories: preference, given conformability, and sense of excitement or fun.

Verbalized protocols (discourses) were analyzed using a concept dictionary and natural language database. To extract the core images (meta-content) behind the words (contents), all verbalized protocols were filtered through associative concept network analysis.

The results showed that the extracted core images among the verbal protocols share a common tendency to relate to “hands” for the knob-type device, which correlated with the “preference” value. Meanwhile, those for the remote control-type device showed a common tendency to relate to “movement,” which correlated with the “sense of excitement or fun” value. Table 1 shows a sample of the obtained contents and related values based on the questionnaire answers of the participants. These results suggest that the cognitive mindset of the participants who interacted with the knob-type device was afforded passive. Thus, this interaction with a device is assumed to evoke an imagination of a living room and resonate with an inner sense of protected space. In contrast, the cognitive mindset of

the subject who interacted with the remote control-type device was active. Such interaction with a device is assumed to evoke an imagination of going out and resonate with an inner sense of adventure.

Table 1. presents contents of discourse; which have high correlative values among the protocols of respondents with interface design (Left: knob-type device; right: remote control-type device)

Preference value		Fun value	
SECONE	0.093549	REPEAT	0.094247
FIVE	0.083336	THAN	0.082412
ABUNDANCE	-0.07626	RETURN	0.081883
EXTREMITY	0.075012	KNOW	0.078214
LIMIT	0.068849	GET	0.069371
COMPANY	-0.0676	BETWEEN	-0.0683
REACH	0.067037	HOLE	0.06643
PLACE	0.06349	LISTEN	0.065378
FINGERNAIL	0.062541	CONTROL	-0.0627

In the analysis, we investigated the cognitive features of interaction design that formed the above types of mindset, which were beyond knowledge of "affordance" so far, and then inspired the user's perspective on the modes of rooms and vehicles. Operation of the device inspired the perspective of the human subject. When the "mode of room" was activated at the cognitive level, the meaning of "car" equaled "protection of the human body," along with specific views on expected preference and comfortable space. However, when the "mode of vehicle" was activated at the cognitive level, the meaning of "car" was recognized as "equipment for going out," along with certain expectations for exciting activities. Both modes are evoked by inner sense through the experience. The above findings of the content analysis in design discourse reveal the usefulness of the procedures of extraction of contents and identification of meta-contents among verbalized words. The formed method of discourse analysis is adapted in the following investigation on the cognitive features present during creative design. Further, they provide new knowledge on affordance, given that the types of mindset were immediately formed through interaction, which suggests the inner sense behind cognitive mode. This analysis will shed light on inner sense of humans when they interact with designed products.

3. Investigation of cognitive features and design creativity

A large number of previous studies have investigated the cognitive features of creative designers, including the creative process, to enhance creative design by human or assist it by computational methods. For example, analogy has been highlighted as a typical aspect of creative cognition, such as in "design by analogy," and has contributed to the development of creativity methods or supporting systems (Markman, et al. 2009; Linsey, et al. 2012). High competence in conceptual blending has been clarified by experimental research (Nagai et al. 2011) and verified by constructive research to benefit design creativity (Taura et al. 2013). For example, analogy has been highlighted as a typical aspect of creative cognition, such as in "design by analogy," and has contributed to the development of creativity methods or supporting systems (Markman, et al. 2009; Linsey, et al. 2012). High competence in conceptual blending has been identified by experimental research (Nagai et al. 2011), and verified by constructive research to benefit design creativity (Taura et al. 2013). These research have challenged the forms of interdisciplinary view on design creativity beyond that achieved by conservative research methodologies. However, design creativity stemming from design sense (inner or social) has not been examined adequately in comprehensive discussions. Indeed, the core reasons underlying the observed cognitive features of socially embedded design creativity remains to be identified.

The discussions in this study are focused on the meta-contents of design discourse. The design discourse was obtained through the survey and experiments conducted in 2012–2013. Figure 2 shows the framework formed to find meta-contents through discourse analysis. Further, the cognitive features in the concept generation phase in design education are examined to extract the dominant meta-contents that will form both the inner and social aspects of design sense. This study detects meta-contents of design sense that will deepen knowledge along with other representations about creative design.

Product design education has a history spanning over 180 years, beginning with the development of the design industry. As such, researchers have a wider opportunity for gathering design discourse contents from different contexts.

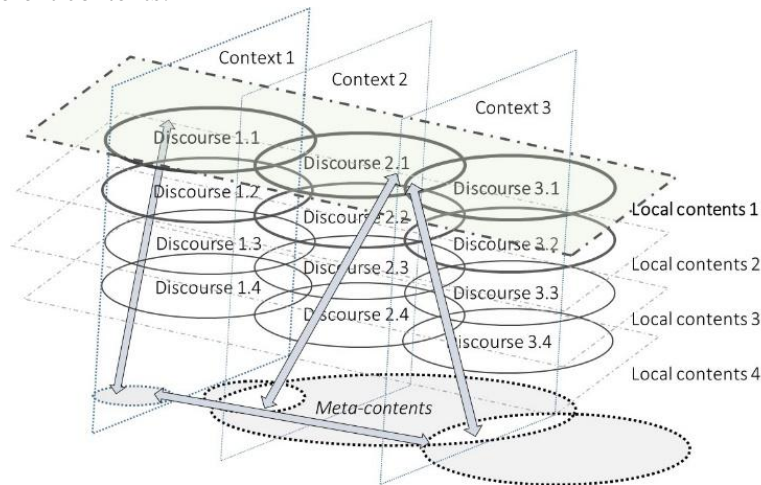


Figure 2. A structural model of contexts, contents, and meta-contents among design discourse

3.1. Extracted cognitive features for designing products

Product design is a targeted domain of this study for the investigation of cognitive features and design creativity. In the previous section, interface design was surveyed in issues related to human-machine interface (HMI). So far, a framework for problem solving had been used and found to be the most rational scheme for HMI. This previous section has developed knowledge of interface design involves understanding the concept of interaction. In other words, a better understanding of human interactions will generate ideas for constructing ideal interface. Therefore, the obtained knowledge from interface design supports provide wider framework of understanding product design of this study.

First, we aimed to capture the essence of design discourse and identify the cognitive features underlying creative design ideas at the concept generation phase during product design education that is within the framework of a human resource development program for the creative industry (Junaidy et al. 2013).

Generally, the educated designers usually consider value of designed products in a concept generation phase. Thus, investigating designers' cognition could suggest the direction of design education at that time, which could correspond to social aspect of design sense. A comparative study of the cognitive features between educated designers and craft artisans who were students of the Human Resource Development program (HRD) was carried out in 2012–2013. The methodology of the discourse analysis was based on the method in section 2. Throughout the comparative study, the cognitive features of designers and craft artisans were extracted, with a focus on the association process in idea generation during the practice. The task was to design a bowl for serving fruits. Table 2 shows the words expressed by three designers (who graduated from university with a major in design) and three craft artisans. The total number of the words did not show a significant difference (213 words for the three designers, and 201 words for the three craft artisans). However, the contents differed. The factorial analysis of the relations between stimuli and associations showed a clear difference between designers and craft artisans. The underlying intention of designers' ideas may be to design based on the surrounding and situation of the fruit bowl, whereas the non-designers' ideas focused on the shapes of the fruit bowl. The results showed that bowl ideas of the designers who did not prioritize shape, offered more functions (Figure 3).

Table 2. Verbalized protocols of designers and craft-artisans

Designers
accommodate, according, added, aesthetic, age, appeal, appear, apple, apply, appreciate, artificial, attention, attractive, available, bamboo, banana, base, basket, big, bowl, box, bread, break, buy, ceramic, chance, character, children, clean, clear, coating, coiling, colour, combine, commercial, community,

concern, etc.
Handcraft-artisan
above, abundant, add, adjust, angle, appear, apple, apply, artistic, asia, attach, ball, bamboo, base, basic, basket, beak, between, big, body, booming, boss, both, box, businessman, buy, buyer, capable, capacity, capital, category, centimetre, ceramic, choose, circle, coating, colour, combine, concern, consistent, etc.

Second, based on the obtained discourse of product design in a framework of education (Design and Creativity Training in HRD), we investigated the inner and social aspects of design sense from the view of creativity. Through the content analysis, we extracted contents and meta-contents of local domains as well as meta-contents of an integrated domain.

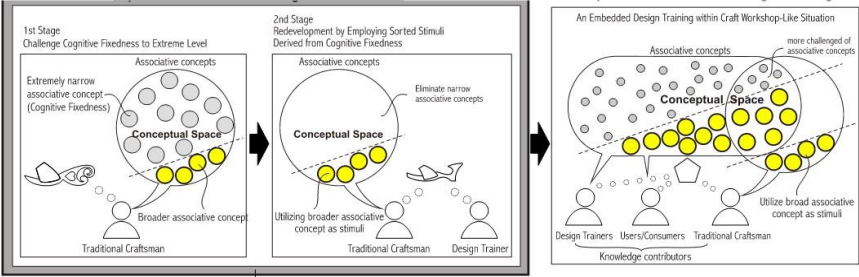


Figure 3. Difference between the discourse contents of designers and craft artisans

3.2. Discussion on design discourse in creative design

Second, based on the obtained discourse of product design in a framework of education, we investigated the inner and social aspects of design senses from the view of creativity. Through discourse analysis, we extracted meta-contents of local domains as well as meta-contents of an integrated domain. The given tasks for idea generation were related to different domains of the product; however, the tendency obtained from the verbalized protocols shared common features. Based on the cognitive modes we found in previous survey using discourse analysis for identifying the sense of interface design, we discuss the underlying cognition during creating product design that will suggest the inner or social sense of design creativity. Figure 3 shows the extracted inner sense of design and cognitive features of designers and students (craft artisans); the ages of members of both groups are almost the same (25 to 40 years old).

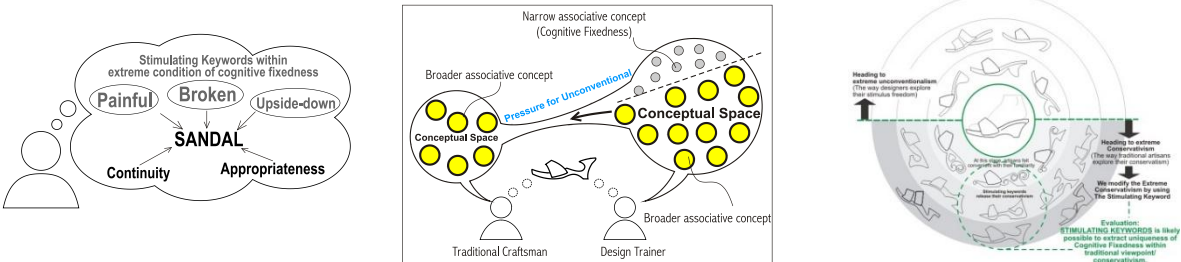


Figure 4. Inner sense underlying cognitive features

In the case of product design education, the results revealed a huge difference between designers and craft artisans who had not received design education. Designers imagine the surroundings and situation of products that will produce the users' experience, whereas craft artisans imagine the shapes of products, which will be a symbol of their design. These cognitions relate to a meaning of enjoyable experience or possession, which will form different modes of values in relation to the products involved the key concepts. The integrated data were analyzed via semantic analysis based on a qualitative analysis method focused on an influence of culture (MacKinnon 1994). With consideration for the influence of culture and habit of the craft-artisans, we conducted the second survey to

investigate behaviors in design, gather the discourse contents of education in the local villages of craft-artisans, and obtain discourse contents from communication among children and parents. We then organized design workshops at craft villages. Throughout the survey, we found that a large number of interactions occurred for skill-based technology; we observed few cases of successful collaborations from the viewpoint of creativity. In comparing the discourse of students (craft artisan) under the Design and Creativity Training in the HRD program and that in villages, we found similarities in cognitive features. Table 3 presents the basic contexts contents of the design discourse obtained from designers, craft artisans (student), and participants of village workshops. The results of the comparison of cognitive-based inner sense and context-based social sense among designers and craft artisans suggest that the formation of a “user model” is different, which is

Table 3. Examples of the context oriented key concepts for forming sense

Context	scheme	users model	contents
1. daily life	usefulness	family, children, parents, friends	party, happiness, foods, rooms, home, garden, cars, hobbies...
2. education	growth	students, teachers, pupils, friends	school, stationary, desk & chair, books, arts...
3. industry	function	designers, engineers customers	products, shapes, materials, machines, factory...
4. market	values	buyers, customers, designers,	shops, internet, price, office, international, business, color...
5. invention	originality	designers, scientist, technologist,	surprising, successful, idea, laboratory, patents, news...
6. environment	sustainability	government, parents, seniors, animals, human	nature, lives, green, global, earth, energy...
7. health	life, beauty	nurse, doctors, patients, seniors,	body, mind, hospital, medicine, gym, sports,

closely related to the social sense. Designers' sense was connected to extensive function for value of the product in market. It is suggested that the different functions of a product stemmed from each social sense caused by environmental conditions. We identified the inner sense of design underlying cognitive features in different domains through discourse analysis. Subsequently, we discussed the rationale for the inner sense by considering the context among different domains which relate with social sense. For a clear understanding the meta-contents of design creativity, qualitative results must be examined via broaden contents analysis focusing on the key concepts among social sense of design.

In examining the rationale that may lead to the essential meanings of design, essential norms that form personal beliefs as well as social value must be identified as embedded in the culture, habits, and lifestyles of people in local communities. Meta-contents represent essential norms, and they can be found through the analysis of the contents of design discourse. In-depth cognition suggests the tendency of a scheme (context) to reveal meta-contents through qualitative analysis. The tendency of a scheme can be understood as local meta-contents. “Local” in this sense is not only a geographical indication but also a design domain.

4. Discussions of meta-contents of design creativity

This section discusses the local meta-contents of design creativity from the design discourse of product design education to find the common meaningful structures that explain the core knowledge of design that is meta-contents. To bridge the different points of local knowledge that represent the different categories of local meta-contents, a systemic approach was used to generate an integrated scheme. Local meta-contents emphasize the originality of design at a particular domain, and various kinds of original designs construct the diversity of culture. This phenomenon stems from the cognitive features of design creativity based on domain-specific knowledge. The local meta-contents of creativity (shape, function, values, etc.) extracted from the design discourses of interaction design and product design education suggest the social sense of design (user model, cultural sustainability, etc.), as well as the integral meanings of design creativity (Table 4). Schemes will suggest the key concept beyond the local context.

Based on this study, we claim the necessity of revitalizing human creativity by changing the paradigm that should influence the change in the meaning of design. Established beliefs in design, such as those related to rational processes or product evolutions, are limited by their values that are based on the context. This perspective suggests the provoking movement of “design thinking,” which has been explained as a competence to lead innovation via creative or active learning within an interdisciplinary

framework and can be seen as a different competence from conventional design. Based on this study, we claim the necessity of revitalizing human creativity by changing the paradigm that should influence the change in the meaning of design. Established beliefs in design, such as those related to rational processes or product evolutions, are limited by their values that are based on the context. This perspective suggests the provoking movement of “design thinking,” which has been explained as a competence to lead innovation via creative or active learning within an interdisciplinary framework and can be seen as a different competence from conventional design (Editorial Board of IJDCI, 2013). We have discussed the meta-contents of design thinking for the future society as regards to the extracted meta-contents of frameworks of design creativity. A reason for this focus is that design thinking is considered to form a base of the design creativity of future society, as it is a form of knowledge that could spark human creativity beyond the established domains. In considering creativity in design, the meaningful future direction of design must be discussed in order to be able to gain knowledge that sparks design creativity and deepens design thinking. The way we develop opportunities that enhance design thinking is the next challenge this study intends to address in future. Toward this end, the extracted meta-contents and methods used in this study will prove helpful. In addition, the contexts of obtained meta-contents will inspire design creativity driven by ever-changing cultural representation, interactive function, and global values, among others. Based on careful understanding of the contexts of meta-contents, the mechanism of change in the meanings of design must be discussed in the education of “deep design thinkers,” who will lead directions toward new meanings of design in the future.

We analyzed discourse in the domain of product design; however, discourse in other domains need to be developed as well. Further, additional investigation of the discourse in other domains of design should be conducted to extract other key concepts. Based on the careful survey of the design discourse extracted among the previous studies, the analytical technology that can deal with large-scale data is expected to benefit future investigations, as well as in-depth review through qualitative observation, such as ethnography. Such integrated research method will be feasible for approaching the sense of design.

5. Conclusion

This study discussed the key concepts to evoke inner and social senses of design by extraction of the meta-contents of design discourse. Understanding the meta-contents obtained through the analysis of the cognitive features of design creativity will promote strengthen the fundamental knowledge on design.

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