Distinctive Features and Game Design

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Abstract

User Experience (UX) is a key feature in game design, where it is known as gameplay. Research on how to achieve better gameplay is ongoing, and it can benefit from theoretical frameworks, such as the Mechanics, Dynamics, Aesthetics (MDA) model [Hunicke et al. 2004], and the distinctive feature (DF) framework, that we proposed in a previous paper [Duarte et al. 2014]. This paper presents further research about the DF framework. In the course of pilot studies, we created a tentative inventory of DFs, with focus on strategical analysis characteristics. Following this, we offered an extension course, in which enrolled participants were asked to play several modern board games, and to evaluate them according to those characteristics. The collected data was compared to our tentative inventory, and the MDA framework offered a key insight in the analysis. The results indicate that the MDA framework can be used as a guideline for the development of new DF systems, enabling game designers to create better products.

Keywords: game design; conceptual design; design research; systems design; distinctive features.

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1. Introduction

It may be surprising to think of game design as a relatively underdeveloped field, at a time when so many digital games are produced and purchased. But we contend that, **as a design field**, game design is still in its early developmental stages. What is still lacking are some of the elements of the philosophy of game design — borrowing some ideas from Terence Love about the philosophy of design [Love 2000] — and especially theoretical frameworks that put them all together.

This situation derives in part from the lack of clearly-defined constraints and requirements, which is itself a consequence of the vast breadth of the gaming experience.

Arguably, one of the key characteristics in a game is **gameplay** — an elusive concept, that can be seen as the result of a large number of game elements [Rollings and Adams 2003, p. 199]. The lack of good formal evaluation methods for gameplay has been decried before [Ip and Jacobs 2004], but research in this topic is ongoing, especially through User Experience (UX) methods (for instance, IJsselsteijn et al. 2007; Drachen and Canossa 2009).

Besides quantifying, there have also been proposals of theoretical frameworks for the analysis of games. In this paper, we focus on two such proposals: the Mechanics, Dynamics, Aesthetics (MDA) framework [Hunicke et al. 2004] and the distinctive feature (DF) framework, that we proposed in a previous paper [Duarte et al. 2014]. Our results indicate that it may be possible to combine both frameworks, and from this combination to derive a mapping from design decisions to user experience in games.

Our previous paper summarized a proposal that was further developed in the course of graduate studies by the first author, with the second author as his advisor [Duarte 2015b]. This paper summarizes these developments. The aim of the research was to create and to evaluate an inventory of DFs which could describe characteristics of strategies in board games. For this, we had the participation of fourteen volunteers, who played board games and answered surveys about their strategies.

Although the research had as its basis the DF framework, during analysis of the collected data the MDA framework provided one key insight. In this paper, we review the role of the game designer, using the MDA framework as a guide. We then describe the main points of our research, and present a discussion of the results.

2. Related Work

The DF framework was proposed in a paper presented to SBGames 2014 [Duarte et al. 2014].

Previous SBGames symposia have featured several papers which featured references to the MDA framework. However, there was a great diversity in uses of this framework, which shows that its significance derives mainly from its use as an analytical tool, and not as practical, hands-on guidelines. Some of the subjects for which MDA was used as an analytical framework can be highlighted:

- proposals about the conceptual design of games [Zaffari and Battaiola 2014]
- UX input on game design processes [Sales 2013]
- rhetoric in games [Moroni and Battaiola 2013]
- game design requirements [Almeida and Silva 2013]

A more practical use of the MDA framework, however uncommon, may be sometimes found; for instance, it was successfully used as an orientation for the design of a serious game oriented towards autistic children [Ceccon et al. 2014].

3. Game designers agency

The design process of a game can involve a multitalented professional team — such as happens in the major digital game studios — but it can often be done by only one person in his off-hours. This last scenario is often the case if the end result of the design process is a board game, or any other kind of game which does not depend on expensive hardware.

The conceptual design of a game does not depend on its budget, however, or on the size of the team. The conceptual designer creates and develops an idea for a game; he is, in a sense, a visionary [Pedersen 2003].

What he intends to create is, in some sense, something more than a game: he wants to create a user experience [Rollings and Adams 2003], through what is usally called gameplay.

In order to create an engaging user experience, the game designer works with the mechanical aspects of the game: tokens, cards, boards, rules. But gameplay is not directly under his control; it will be an emergent feature [Sweetser 2008, p. 3] of the game; that is, it will be produced by the synergy of the game system when played.

The game designer is thus in a peculiar position. His work will completely define the scope of agency for the players; but his own agency is not enough to completely define the emergent gameplay, even if it is a result of the players' limited agency.

This tension between the scope of the designer's agency and the emergent gameplay is an important feature of "A Formal Approach to Game Design and Game Research" [Hunicke et al. 2004]. In this paper, the authors propose a framework for game analysis based on three layers: **Mechanics**, **Dynamics**, and **Aesthetics**. The game designer acts on the Mechanics layer; he has no direct control over the Dynamics and the Aesthetics layers, but he creates and combines the game components (Mechanics) in order to

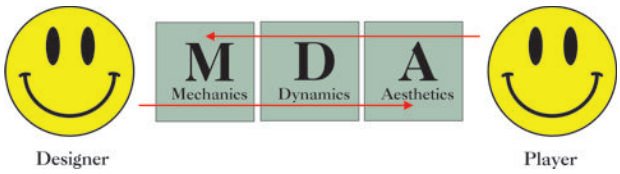

Figure 1: The MDA agency diagram [Hunicke et al. 2004]

elicit a desired behaviour (Dynamics) or experience (Aesthetics).

The designer's agency is thus unidirectional, and it is mirrored by the user's agency:

> From the designer's perspective, the mechanics give rise to dynamic system behavior, which in turn leads to particular aesthetic experiences. From the player's perspective, aesthetics set the tone, which is born out in observable dynamics and eventually, operable mechanics.
>
> [Hunicke et al. 2004]

The complementary agencies are illustrated by a diagram (fig. 1). However, this model fails for many games, such as board games — in which the player must perforce learn the rules **before** playing. Based on this limitation, one of us proposed a modified agency diagram (fig. 2) [Duarte 2015a].

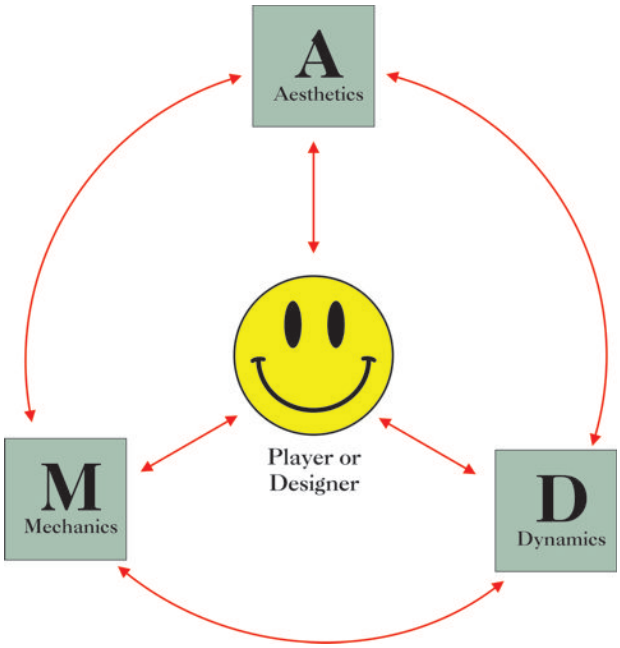

Figure 2: The modified MDA agency diagram [Duarte 2015a]

The MDA framework is a useful analysis tool. However, its strength in analysis is not matched by its relevance for the design process. How can a game designer ascertain the effects of his Mechanics layer decisions over the Dynamics and Aesthetics layers is not explained.

4. Working with Distinctive Features

The study of DFs has long been an important aspect of Linguistics, especially after the publication of *The Sound Pattern of English* [Chomsky and Halle 1968]. In its simplest form, DFs are an inventory of categories, created in order to represent the relevant characteristics of a phenomenon.

We first proposed the use of DFs in game studies Duarte et al. (2014). But this was a theoretical proposal; although we presented therein an example of a DF-based framework, it was a thought experiment.

Nevertheless, that proposal was the starting point for our research, conducted as part of a master's degree in Design Studies; we intended to create a DF inventory for games, based on empirical data. The chosen scope for this work was the **strategical analysis** process — that is, the process whereby a player learns a new game, and tries to determine which steps he must take in order to win. We understand a **strategy** in a game as a set of moves that a player adopts in order to win the game.

Strategical analysis data were collected during a 40-hour extension course on modern board games. During most of the 4-hour sessions, enrolled participants were introduced to new games, and played them to conclusion. Before and after playing, participants were asked to fill surveys, in which there were several questions about elements of the strategical analysis process.

The surveys were developed after a series of pilot sessions, which revealed some key elements of the strategical analysis process. These preliminary findings provided a tentative inventory of DFs:

[±balanced] the game offers equal winning chances for all players

[±experience-rewarded] playing several times can enhance a player's strategical ability

[±random] random events are decisive in the game

[±strategy-possible] the game enables the pursuit of a strategy

[±strategy-variable] there is more than one worthwhile strategy available

[±symmetric] all players share the same abilities and objectives

[±theme-present] the game features a theme

[±theme-relevant] knowledge of the theme featured in the game helps to create a strategy

There were fourteen participants: eight undergraduate students, five graduate students, and one full professor. Their fields of study were varied: nine from Design, and one each from History, Economy, Arts, Information Technology, and Electrical Enginnering. The participants were separated in two five-people groups and one four-people group.

Seventeen games were selected for the course; each one of them was played twice, always by the same group, with at least one week between plays.[1]

Figure 3: Playing *Ticket to Ride*

Before first playing a new game, the course moderator presented the rules, and then the players were asked to fill out the pre-game survey. This survey asked questions about the expectations of the players, what were their impressions on balance and symmetry of the upcoming game, and whether they intended to use a strategy. After filling out the surveys, playing ensued.

After playing, the players were asked to fill out the post-game survey. The questions asked for the player to evaluate his expectations, contrasting them with the actual game experience, and also to suggest changes in his strategy for future games.

The same procedure was followed for the second play of each game. The rules were briefly presented again, and the surveys were filled out before and after playing.

During the rules presentation, and while players were filling out the surveys, the moderator avoided any comments that could be construed as suggestions on how to answer.

Several questions were framed as yes/no binary alternatives, although a few questions included a five-item scale ("How do you evaluate the complexity of this game?").

Most questions included some key concepts, which were explained in the surveys themselves. For instance, the pre-game survey included the following definition:

> A game is said to be **balanced** if all players have an equal chance of winning (without reference to their experience).

This was followed by the question, "Do you believe this game to be balanced?", with yes/no answers. A negative answer was followed by a space in which the player should explain why he thought the game was unbalanced.

The surveys of each play were evaluated together, generating a weighted average, in which we attributed weight 1 to the pre-game survey and weight 2 to the post-game

[1] In this paper, we deviate somewhat from good English writing practices. The English language lacks a word for "a playing of a game", unlike Portuguese ("partida"). We use "play" in this sense throughout (as in "1st play" and "2nd play").

survey. After calculating the weighted averages for both the first and the second plays of a game, a new weighted average was calculated, in which we attributed weight 1 to the first play result and weight 2 to the second play result.

The weighted averages for **[±experience-rewarded]** can be seen in table 1. In the DF evaluation, we considered that a given DF was perceived as present (**[+]**) if the final weighted average was greater than 0.5, as absent (**[–]**) if the final weighted average was lesser than -0.5, and non-determined for values between -0.5 and 0.5.

Table 1: Evaluation of **[±experience-rewarded]**

Game	1st play	2nd play	Final	DF
Age of Empires III	0.67	1.00	0.89	[+]
Container	1.00	0.50	0.67	[+]
El Grande	1.00	0.50	0.67	[+]
Flash Point	1.00	0.60	0.73	[+]
Goa	1.00	1.00	1.00	[+]
Inkognito	1.00	0.00	0.33	undefined
Kill Doctor Lucky	1.00	1.00	1.00	[+]
Lord of the Rings	0.00	-1.00	-0.67	[–]
On the Underground	1.00	1.00	1.00	[+]
Paris Connection	1.00	0.50	0.67	[+]
Pastiche	0.50	-0.50	-0.17	undefined
Ra	1.00	0.50	0.67	[+]
Room 25	1.00	1.00	1.00	[+]
San Juan	0.33	0.00	0.11	undefined
Steel Driver	1.00	1.00	1.00	[+]
The Speicherstadt	1.00	0.00	0.33	undefined
Ticket to Ride	1.00	1.00	1.00	[+]

The **[±random]** DF was subjet to a slightly different evaluation, since it depended on the answers to two questions in the surveys.

The first question was in the pre-game survey, and it asked the player to evaluate in a five-point scale the expected impact of luck in the upcoming game. We attributed values ranging from 1.00 to $--1.00$ to each of the answers (table 2).

Table 2: The values for impact of luck evaluation

This game is completely luck-based	1.00
Skill helps, but luck is paramount	0.50
Skill and luck are equally important	0.00
Luck helps, but skill is paramount	-0.50
Luck has no impact on this game	-1.00

The second question was in the post-game survey, and it asked "Do you believe that the result was influenced by luck?" The answers to this question were evaluated as per the other binary questions, above.

In each play, the value for **[±random]** was calculated as the sum of the pre-game question's value and twice the post-game question's value (evaluated as per the previous binary questions). This resulted in a value varying from -3 to 3.

The calculated values for each play were then submitted to the same weighted averaging as the other DFs. The result was evaluated as **[–random]** if the final value was less than -1.5, as **[+random]** if the final value was greater than 1.5, and as undefined for values between -1.5 e 1.5.

The weighted averages for **[±random]** can be seen in table 3.

Table 3: Evaluation of **[±random]**

Game	1st play	2nd play	Final	DF
Age of Empires III	-2.75	-2.50	-2.58	[–]
Container	-1.63	-1.63	-1.63	[–]
El Grande	-2.25	-2.25	-2.25	[–]
Flash Point	-1.90	-1.20	-1.43	undefined
Goa	-2.67	-2.33	-2.44	[–]
Inkognito	-2.25	-1.25	-1.58	[–]
Kill Doctor Lucky	-2.00	-2.10	-2.07	[–]
Lord of the Rings	2.00	2.25	2.17	[+]
On the Underground	-1.50	-1.40	-1.43	undefined
Paris Connection	-1.20	-2.63	-2.15	[–]
Pastiche	0.13	-1.25	-0.79	undefined
Ra	0.13	-2.13	-1.38	undefined
Room 25	-1.90	-2.10	-2.03	[–]
San Juan	-0.67	-0.25	-0.39	undefined
Steel Driver	-2.50	-1.63	-1.92	[–]
The Speicherstadt	-0.75	0.00	-0.25	undefined
Ticket to Ride	-1.50	-2.00	-1.83	[–]

5. Analyzing the results

The consolidated DFs for each game, according to the answers in the surveys, can be found on table 4 (on the following page).

Several results were puzzling, to say the least. Detailed analysis revealed many cases in which answers from a given player were mutually contradictory, or even contrary to reality.

For instance, it was surprising to see a fully cooperative game (*Lord of the Rings*) being evaluated as unbalanced by several players. In this game, either all players win together, or else they all lose together. Thus, by design and by definition (see above), this is a balanced game, and players in the first play unanimously agreed with this. However, *Lord of the Rings* is a difficult game, and in the second play three of the players (who had played in the first play) declared the game unbalanced — and based their answers on the great difficulty and the great impact of random effects.

Sometimes survey answers were very hard to reconcile. For instance, in the post-game survey of the second *Ra* play, one of the players evaluated his performance as "good",

Table 4: The DFs of each game, according to survey results.

Game	random	balanced	strategy-possible	strategy-variable	experience-rewarded	symmetric	theme-present	theme-relevant
Age of Empires III	–	+	+	+	+		+	–
Container	–	+	+	+	+	+	+	
El Grande	–	+	+	+	+	+		–
Flash Point		+	+	+	+		+	
Goa	–	+	+	+	+		+	–
Inkognito	–	+				+		
Kill Doctor Lucky	–	+	+	+	+	+	+	–
Lord of the Rings	+				–			
On the Underground		+	+	+	+	+	+	–
Paris Connection	–	+	+	+	+	+	+	–
Pastiche								–
Ra		+	+		+			–
Room 25	–		+		+		+	–
San Juan		+	+			+		–
Steel Driver	–	+	+	+	+	+		–
The Speicherstadt		+				+		–
Ticket to Ride	–	+	+		+	+	+	–

and justified this by saying that "my play was passable". We found several surveys in which the players claimed that it was not possible to formulate a strategy for the upcoming game, and in the very next question sketched what strategy they would follow.

On the other hand, there were sometimes confusion between concepts. This happened, for instance, with players' evaluation of *Room 25* with respect to **[±balanced]** and **[±symmetric]** DFs. This game is played in two teams, with different objectives and powers, which makes it an asymmetric game. But several players considered *Room 25* as a symmetric, unbalanced game; when asked why was the game unbalanced, they justified this by the differences between the two teams' powers and objectives. Those players' perception led to "undefined" values for **[±balanced]** and **[±symmetric]** in *Room 25*.

Even when a characteristic was noticed, the justification presented was sometimes quite odd. In the pre-game survey for *Age of Empires III: The Age of Discovery*, two out of six players noticed asymmetry and correctly identified its source (the different powers for each player). Three players did not perceive any asymmetry; the remaining player declared that the game was asymmetric "because each player does what he wants".

Some of the most surprising answers were about the games' themes. For instance, *Flash Point: Fire Rescue* is a game in which players represent firefighters trying to save people from a house aflame; but three players identified its theme as "logistics", "tactical military positioning", and "cooperation, team". Sometimes the theme wasn't even identified; one of the players in *Kill Doctor Lucky* — a game about the murder of an old man — answered that the game had no theme.

Random elements were also perceived from a somewhat askew perspective. Both *Age of Empires III* and *Container* were evaluated as **[–random]**; but although both games' weighted averages were negative, *Age of Empires III* (-2.58) was considered less random than *Container* (-1.63). However, *Age of Empires III* has many random effects, while *Container* is completely deterministic.

Some answers further illustrated the players' perception about randomness. Very often a player mentioned that he benefitted from a move by another player, and he would then say "I got lucky". Conversely, if his strategy was harmed by another player's move, he would then claim to have suffered "bad luck".

Many of these unexpected results originated in problems inherent to the data collection process. Surveys are notoriously tricky [Foddy 1993], and it is probable that several answers were influenced by other players' perceptions of the games, since it would be impractical to ask the players not to talk while playing, or afterwards.

Also, many of the enrolled participants had no experience with modern board games, or even with traditional strategy games. It was very common to hear comments like "I don't know what to do" or "I'm lost" during sessions, and the players' answers have to be evaluated according to this circumstance.

However, this lack of experience does not in any way depreciate the value of their answers. On the contrary: what we strived to do was to ascertain how some features of a game were **perceived** by players — no matter whether experienced players or complete novices.

Figure 4: Playing *Container*

In this sense, there were no "wrong" answers. Even so, we had some expectations about the answers, based on our experience with the games.

The contrast between what we expected and what we got from the participants would reveal itself as the key which unlocked the significance of our findings.

6. Evaluation

We have indicated above that there were several problems in the answers of the players. But some problems resulted from the proposed DF inventory itself. To begin with, some characteristics do not lend themselves well — or at all — to a binary evaluation. For instance, "is game X random?" is a very difficult question; while *Craps* clearly is random, and *Chess* clearly isn't random, what about *Backgammon* or *Bridge*?

We tried to compensate for this with five-point scales, as in the case of the pre-game survey question on expected effects of luck. But enhancing the resolution of the viewpoint ("zooming in", as it were) cannot transform a continuous phenomenon in a discrete one.

Representing a continuous reality by means of a discrete system is a well-known problem, and this will always be a limitation of a DF system.

Another problem is that any formal system — such as the DF framework — can lend itself to **overgeberation**, that is, there are situations which can be represented in the system, but which have no correspondence in reality. Thus, a game can certainly be **[+balanced, +symmetric]** or **[–balanced, –symmetric]**, and there are several games that are **[+balanced, –symmetric]**, but there can be no game that is **[–balanced, +symmetric]** — since its unbalance could only originate in an asymmetry. However, in this system, the **[–balanced, +symmetric]** vector is formally valid.

But there was a more subtle issue with our proposed DF inventory, which we noticed during evaluation of the results. Going back to the MDA framework, it became evident that the DFs in our inventory referenced characteristics from the three layers of game experience. Thus, for instance, **[±symmetric]** lies squarely in the Mechanics layer, since it is the designer who defines the abilities and objectives of the players. This is, then, an objective characteristic.

On the other hand, **[±balanced]** is a Dynamics layer feature. A designer may intend to create a **[+balanced]** game, but even a **[+symmetrical]** game can be slightly unbalanced — witness the first player advantage in *Checkers* or *Chess*.[2]

We even have in our inventory an Aesthetic layer feature, **[±theme-relevant]**. Board games with interesting themes can attract new players; but no matter how well any given theme is implemented, it will not be perceived as **[+theme-relevant]** unless the player knows the theme well enough to foresee consequences to his actions in play from his knowledge.

Our DF inventory, then, presented features from three different aspects of the game experience. The mechanical aspect is the most amenable to objective investigation, since it is itself created by objective rules and decisions. But the dynamic and the aesthetic aspects of the game experience are deeply influenced by the human factor, and the features in these layers are subjective. This dichotomy, mixing objective and subjective features in our inventory, was the origin of several problems with the results — or rather, what we perceived as problems.

It should come as no surprise that a game system can present a great degree of synergy when actually played by humans, thus creating emergent dynamics [Sweetser 2008, p. 3]. As a matter of fact, even if the game system was to be played entirely by automata, emergent features could be expected:

> Universal codes and universal machines, introduced by Alan Turing in his "On Computable Numbers, with an Application to the Entscheidungsproblem" of 1936, have prospered to such an extent that Turing's underlying interest in the "decision problem" is easily overlooked. In answering the *Entscheidungsproblem*, Turing proved that there is no systematic way to tell, by looking at a code, what that code will do. That's what makes the digital universe so interesting, and that's what brings us here.
>
> [Dyson 2012, preface]

7. Final remarks

The research briefly described above has just scratched the surface of the possibilities of a DF-based framework in game studies. The problems that our data revealed can be put to good use in perfecting the DF framework.

The main result of our research lies in showcasing that the DF framework is not the be-all and end-all answer to a theoretical analysis of games; rather, it needs to be used together with other theoretical models. The MDA and

[2] Cf. http://chess.stackexchange.com/questions/2017/does-white-have-an-advantage.

the DF frameworks can perhaps be better understood as representing different levels in Terence Love's structure for the philosophy of design [Love 2000, p. 305].

Using the MDA framework as a guide, we can now see that a DF inventory should include only DFs from the same layer of the game experience. Thus, a DF inventory for the Mechanics layer would be composed by DFs pertaining to design decisions, while a Dynamics DF inventory would include characteristics resulting from actual playing experience.

This begs the question: are DF inventories possible for the two subjective layers?

Let us turn to a field of knowledge where the DF framework has been put to good use. DFs are very relevant in Linguistics due to their ability to represent sounds of human speech, with each sound represented by a unique DF vector.

But human speech goes beyond sounds — in that the emergent, dynamical features of the language system are created by the use that human beings put to the sounds. And the "higher" levels of language still resist representation of its characteristics by formal frameworks [Baikadi and Cardona-Rivera 2012].

A DF inventory able to represent all games seem unattainable. While human speech sounds are constrained by physiological and physical imperatives, games are a result of human creativity, and thus are almost completely boundless. The database in boardgamegeek.com already contains more than 76,000 games, and this does not include digital games or role-playing games. Figuring in variants of indexed games, it would point to the need of at least 18 DFs ($2^{18} = 262,144$) — probably several more, especially because there would almost certainly be some DFs which would be dependent on other ones.

However, even if it seems unlikely that such a comprehensive DF inventory can ever be devised, it may be possible to create a DF inventory for the Mechanics layer, and perhaps even a DF inventory for the Dynamics layer. Such inventories may perhaps be the result of an incremental development; recently, we have proposed a DF inventory for cooperative games, with focus on the Mechanics layer [Duarte et al. 2015].

Mechanics and Dynamics DF inventories would already be useful analytical tools. But the really exciting development would be the development of a formal grammar, capable of mapping Mechanics DFs to Dynamics DFs. This would enable game designers to more precisely craft their products, using their agency on the Mechanics layer to create the desired Dynamics effects.

Figure 5: Playing *Kill Doctor Lucky*

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