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Beyond the 'Idols of the Marketplace': Managing Semantic Change in Research

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Introduction: The Nature of Semantic Shifts

The evolution of language within and across academic fields often leads to semantic change, wherein terms acquire new meanings as they are adapted to different contexts (Bréal, 1900; Traugott & Dasher, 2002). This semantic change becomes especially pronounced where disciplines converge or when familiar concepts are reinterpreted to meet the requirements of new fields. While this fluidity of meaning is essential for intellectual progress, it also creates challenges, particularly in interdisciplinary work, where terms may carry multiple, and sometimes conflicting, interpretations (Stein, 2007).

Francis Bacon, in his *Novum Organum* (1620), identified this risk in his discussion of the "Idols of the Marketplace" and the fallacies that arise from careless language in public discourse. Bacon argued that words, when traded freely in human interaction, often lose precision, leading to misunderstanding and confusion (Jardine, 1973). This observation remains highly relevant in contemporary academic settings, where terms frequently move across disciplines and thereby risk losing clarity (Frost & Jean, 2003).

For example, the term agent, derived from the Latin *agere* meaning 'to act' (“Agent,” Oxford English Dictionary, 2024), has generally referred to a human entity with the capacity to act intentionally, often guided by mental states like beliefs and desires (Schlosser, 2019). In legal contexts, this typically involves acting on behalf of another party under a contractual or fiduciary relationship (“Agent,” Black's Law Dictionary, 2024). However, in artificial intelligence research, the term has been redefined to describe autonomous systems capable of acting independently within digital environments or in the world (Russell & Norvig, 2020).

Just as "agent" has broadened from describing intentional human actors to include autonomous systems, "ontology" has transitioned from a philosophical inquiry into existence to a practical framework in information science and AI research. While ontology once focused on fundamental questions about being and reality, it now denotes structured knowledge frameworks supporting computational models (Flouris et al., 2006), particularly in fields like Explainable AI. Here, ontology

organizes and traces connections between system decisions, underlying data, and reasoning processes (Confalonieri et al., 2024; Chari et al., 2020).

While such semantic shifts reflect the dynamic nature of academic inquiry, they also present challenges for interdisciplinary research, where differing meanings of terms can complicate communication. Tracking these shifts and understanding their implications can be valuable for maintaining clarity and consistency across fields.

This paper examines the evolution *agent* and *ontology* as representative terms, tracing their semantic shifts across disciplines such as philosophy, law, and computer science. Using these terms as case studies, the analysis draws on metacognitive frameworks, as suggested by Stenseke (2022), and builds on Boon and Van Baalen's (2018) work. These frameworks, which help track terms both across and within disciplines, incorporate a temporal dimension to better follow and address changes in meaning over time. This discussion contributes to ongoing efforts to enhance clarity and consistency in academic discourse, offering approaches to managing the complexities of evolving terminology.

Theoretical Background

Semantic Change

In examining how language evolves, the concepts of diachronic change and polysemy are particularly useful for understanding semantic change more broadly. These concepts offer insights into how words shift in meaning across time and contexts, particularly relevant in analyzing semantic shifts within interdisciplinary or rapidly evolving fields.

Diachronic change refers to the process by which the meanings of words evolve across historical periods, shaped by external factors such as cultural, technological, and societal changes (Kutuzov et al., 2018). This evolution tends to follow observable patterns, with word usage shifting over time in response to these external forces. One such pattern is the law of conformity, which suggests that more frequent words change more slowly, maintaining greater stability across time (Hamilton et al., 2016). This principle demonstrates that linguistic shifts are not entirely random but follow systematic tendencies based on usage patterns.

Polysemy refers to a word's ability to develop multiple related meanings. This phenomenon contributes to linguistic flexibility, allowing words to adapt to new contexts while retaining connections to their original meanings (Vanhove, 2008). However, this flexibility can introduce ambiguity, particularly in interdisciplinary settings where clear communication is essential. Polysemous words also tend to undergo more frequent semantic shifts, linking polysemy with faster rates of change (Hamilton et al., 2016).

The interplay between diachronic change and polysemy offers further insight into how terms evolve both within and across domains. Diachronic change captures the historical progression of word meanings, shaped by external factors and following patterns such as the law of innovation, which suggests that words with more meanings (polysemous words) tend to change more rapidly (Hamilton et al., 2016). Polysemy also reflects the development of multiple, related meanings, enabling words to adapt to new contexts while retaining their original sense, though it can introduce ambiguity in interdisciplinary settings (Vanhove, 2008). These concepts, when considered within a broader context, can help illustrate the nature of semantic change and how meanings shift over time and across different fields.

Interdisciplinary Shifts

When terms migrate between disciplines, they often undergo substantial redefinition, leading to shifts that are more than mere domain adaptations. The integration of terms into new fields often results in the development of specialized meanings that serve the unique conceptual frameworks and practical needs of the adopting discipline. This process can lead to terms existing simultaneously in multiple fields, each with distinct and sometimes conflicting meanings. Applied disciplines, in particular, face challenges in establishing clear theoretical foundations because their theoretical components are often shaped by the dynamic needs of practice and the integration of theories from multiple contributing fields (Swanson, 2007).

A key challenge presented by these interdisciplinary shifts is that as different fields appropriate common terms, they may impose unique constraints and features, diverging from both the original meaning and the everyday usage of the term. Over time, these redefined terms can become ingrained in each field's academic literature, developing specialized connotations that differ significantly from their

use in other domains (*Encyclopedia of Language & Linguistics*, 2006). For instance, terms originating in philosophy or law, such as our examples, *agent* and *ontology*, are commonly adopted by fields like computer science and further subsumed in specialized fields such as artificial intelligence research, where they take on new technical distinctions that differ not only from the original field but also from each other. As Swanson (2007) emphasizes, the development of core, contributing, and useful theories in applied disciplines often leads to tensions between academic discourse and practical application. These evolving meanings complicate communication, as researchers from different disciplines may use the same word in incompatible ways.

Disciplinary capture occurs when a term becomes narrowly defined by the standards of one discipline, making it difficult for scholars from other fields to engage with it in its broader, narrower, or original sense. This phenomenon can create barriers to interdisciplinary research as the term becomes increasingly specialized and inaccessible to those outside the field. Early decisions in interdisciplinary projects often favor one discipline's epistemological framework, leading to the exclusion of others as the project progresses, and this is a core feature of disciplinary capture (Brister, 2016).

In academic contexts, terms can act as gatekeepers, where specialized meanings within a particular field restrict accessibility to scholars from different disciplines (Lucy et al., 2023). As a result, terms evolve to meet the unique needs of a field, becoming difficult for others to interpret. This fragmentation makes interdisciplinary communication and collaboration more difficult, as seen in cases where fields progressively refine terms based on their specific methodologies and goals (Boon & Van Baalen, 2018).

Over time, the narrowing of definitions within disciplines can obscure the original or broader meanings of terms, reinforcing intellectual silos and further entrenching disciplinary capture. As these distinctions solidify, interdisciplinary work becomes more challenging because the technical language no longer has shared meaning across fields (Boon & Van Baalen, 2018). Miscommunication in such projects arises when terms are assumed to carry the same meaning across disciplines, leading to misunderstandings that can undermine collaborative efforts (Brister, 2016).

To address these issues, researchers have proposed metacognitive frameworks to help scholars remain aware of the different ways terms are defined and used across disciplines. Such frameworks encourage a deeper understanding of how terms evolve within individual fields while diverging in other disciplines, thereby improving communication in interdisciplinary contexts (Boon & Van Baalen, 2018). This approach underscores the need for unambiguity and specificity in language use to prevent miscommunication and the perpetuation of misunderstandings, especially when precision is critical for the success of the research (Brister, 2016; Stenseke, 2022).

Case Studies of Semantic Shift Across Disciplines

Case Study 1: The Term "Agent"

Origin in Philosophy, Law and Economics:

In philosophy, the term *agent* refers to an entity capable of intentional action and is implicated in discussions of free will and moral responsibility. Philosophical agents are individuals who can act based on reason, exercising autonomy over their decisions and, therefore, bearing moral accountability for their actions. This concept is integral to debates about how human beings initiate actions independently of external compulsion, focusing on rational agency and ethical behavior (Schlosser, 2019). Notably, in this sense, agents are defined by their capacity to make independent choices that align with moral and rational considerations.

In law, the concept of agency centers around a principal-agent relationship, where one party (the agent) is authorized to act on behalf of another party (the principal). In legal contexts, an agent is someone authorized to act in the interests of the principal, often under a contractual framework. Black's Law Dictionary defines an agent as "someone who is authorized to act for or in place of another," emphasizing the agent's role as a representative and the subordination relation (*Black's Law Dictionary* 2nd ed., 1910). The legal concept of agency encompasses the authority

and duties of agents, including the liability for actions conducted within the scope of their authorization[1].

Similarly, in economics and business, agency theory explores the delegation of decision-making authority from the principal to the agent, focusing on challenges like moral hazard and information asymmetry. The principal-agent relationship in this context raises concerns about ensuring that the agent's actions align with the principal's interests, as agents may have incentives to pursue their own goals instead of the principal's (Eisenhardt, 1989). Both fields share the core issue of managing the risks and responsibilities involved in acting on behalf of others.

These alternative uses of the term *agent*, such as in chemistry or figuratively as a catalyst for change, might not cause the same confusion because they are typically understood within the specific contexts in which they are used. In chemistry, for example, an agent refers to a substance that triggers a reaction, and in figurative language, an agent often symbolizes someone or something that causes change. These uses are distinct and well-contained within their respective fields, where their meaning is generally unambiguous. In contrast, the legal and philosophical sense of agent involves more complex considerations of responsibility, autonomy, and authority, which can overlap with different interpretations of action and agency as used in computer science, thus leading to more potential for ambiguity or confusion in interdisciplinary discussions.

Shift to Computer Science:

In computer science, the term agent has evolved significantly from its original meanings in philosophy, law, and economics, where it refers to entities with moral accountability or legal authority to act on behalf of another. Building on the traditional concepts, the term was adapted to describe software agents performing

[1] Note the 12th edition of Black's Law Dictionary (2024) cites Floyd R. Mechem's possibly paradoxical statement that anyone capable of performing the necessary functions can act as an agent, including those legally incapacitated, such as infants or individuals with severe mental impairments. Mechem explains that while an agent typically binds the principal, not themselves, it is not essential for the agent to be legally competent to contract. However, he notes that a court would likely disregard actions by someone too young or mentally impaired to understand their role, quoting Mechem, 1952. The focus is on the agent's practical ability to act, though courts may intervene when the agent is clearly incapable. This observation raises intriguing parallels with the competence of artificial agents, where the law may similarly need to grapple with the extent to which non-human entities can fulfill agency roles without traditional legal capacity.

tasks autonomously on behalf of a user or another program. The Oxford English Dictionary (2024) defines a software agent as "a software program that performs actions on behalf of a user or another program," indicating its role as a digital intermediary.

However, the concept of agency in computing has expanded further in the context of artificial intelligence (AI). According to Russell and Norvig (2020), an AI agent is an autonomous entity that perceives its environment through sensors and acts upon it using actuators to achieve specific goals. These agents differ from earlier software agents in that they are not merely tools executing predefined tasks; they are semi-rational entities capable of making decisions and optimizing their behavior based on environmental inputs. This shift highlights the increasing perception of the autonomy of AI agents, as they operate without continuous human intervention. The degree of independence and perceived rationality that AI agents exhibit in this conception marks a significant departure from traditional agents in law, where they typically act based on delegated authority or philosophy, where they act with moral accountability.

The evolution of the term *agent* across disciplines illustrates how concepts adapt to fit the needs of specific fields. In law and economics, the core notion of an agent acting on behalf of another remains central, but in computer science, the degree of autonomy and responsibility varies significantly. The term broadly encompasses entities ranging from legal representatives to autonomous software systems acting independently or on instruction, reflecting the growing interrelation between disciplines. Accordingly, this increasing overlap requires careful attention to context to avoid confusion when the term is applied across different fields.

Case Study 2: The Term "Ontology"

Philosophical Origins:
Ontology originates in metaphysics as the branch of philosophy concerned with the nature of being and existence. Aristotle's Metaphysics laid the groundwork for ontological inquiry, focusing on the categorization of entities and the relationships between different kinds of beings. Ontology, in this classical sense, involves the study of what exists and how entities can be categorized based on their properties and relationships ("Ontology," Oxford English Dictionary, 2024; Hofweber, 2023)

Shift to Information Science:

In information science and later in AI research, the term *ontology* evolved to refer to formalized systems for structuring and representing knowledge. Thomas Gruber defined ontology as "an explicit specification of a conceptualization," highlighting its role in creating frameworks that enable machines to process and interpret domain-specific knowledge (Gruber, 1993). Ontologies serve as structured representations of relationships between concepts, improving communication between machines.

More recently, ontologies have evolved from frameworks primarily used for structuring information into tools that also provide explanations for system outputs. In addition to organizing knowledge, they now link system decisions to underlying data and models, offering a way to trace how conclusions are reached. This shift has been particularly important in AI and explainable AI (XAI), where the focus is on making system decisions more interpretable. Ontologies have thus transitioned from abstract categorizations of knowledge to systems that also serve as mechanisms for generating explanations of their own processes (Chari et al., 2020; Confalonieri et al., 2021).

Temporal Dimensions of Semantic Shifts

The meanings of terms shift significantly as they move across disciplines. Tracking these semantic shifts over time is essential for understanding how terms evolve within and between fields. Hamilton et al. (2016) introduced tracking through diachronic word embeddings, a method that provides valuable tools for mapping these shifts, enabling researchers to visualize when and how terms develop new meanings or adapt to different contexts.

Research such as Fišer and Ljubešić's (2018) work on social media data demonstrates how terms can develop new senses in contemporary, informal contexts while retaining older meanings in more formal or academic settings. This dual existence highlights the complexity of semantic shifts, where factors like context, register, and medium contribute to changes in meaning. Although diachronic methods using word embeddings offer valuable insights into the temporal evolution of terms, they may not fully account for the complexities of interdisciplinary uses, where meanings can diverge sharply.

Parallel Meanings Across Disciplines

Terms frequently develop parallel meanings that coexist across different fields. For example, in legal contexts, *agent* refers to a human actor authorized to act on behalf of another party, while in AI it denotes autonomous systems capable of independent action (Russell & Norvig, 2020). Similarly, *ontology* has evolved from its philosophical roots as the study of being to a structured framework for knowledge representation in information science (Gruber, 1993) and explainability in AI. These divergent meanings can complicate interdisciplinary collaboration, as researchers from different fields may use the same term with varying implications.

While temporal tools like word embeddings can map when terms shift in meaning, they do not always capture the interdisciplinary tensions that arise when terms acquire specialized meanings in different contexts. To address these challenges, metacognitive frameworks can be used to systematically analyze and mitigate potential conflicts that stem from evolving definitions.

Introducing Metacognitive Frameworks

A useful approach for managing the complexities of evolving meanings is through metacognitive frameworks. Originally developed in cognitive psychology by John Flavell in the 1970s, metacognition refers to the process of reflecting on one's own thinking. Boon and Van Baalen (2018) adapted this concept for interdisciplinary research, emphasizing the importance of self-awareness in tracking how key terms are defined and used within one’s discipline and how these definitions might diverge in other fields. This reflective approach helps prevent disciplinary capture, where a term’s meaning becomes rigidly defined within a particular field, obstructing interdisciplinary communication.

Although Boon and Van Baalen did not introduce the concept of metacognition, their application of it to interdisciplinary research is particularly valuable. By encouraging scholars to reflect on how terms evolve within and across disciplines, they provide a strategy for avoiding narrow definitions and promoting flexibility, which is essential for effective interdisciplinary collaboration.

Applying a Metacognitive Framework to "Agent" and "Ontology"

To illustrate how metacognitive frameworks can be applied, the terms *agent* and *ontology* are explored below. This bird's eye view allows for flexible application, depending on the specific needs and level of detail required for the relevant case.

Metacognitive Framework for Agent and Ontology

The framework follows these structured steps:

1. **Categorize Key Terms Across Disciplines:** The first step involves organizing key terms across disciplines and noting how their meanings shift depending on the context. This table provides a basic example for mapping variations, but an actual implementation or one used in a project might require additional specificity depending on the context.

Definitions of "Agent" Across Disciplines

Discipline	**Definition**	**Source**
Philosophy	A being with the capacity to act intentionally and autonomously; often discussed in the context of moral responsibility and free will.	*Stanford Encyclopedia of Philosophy* (2023)
Legal	A person authorized to act on behalf of another person or entity, particularly in business or legal matters.	*Black's Law Dictionary* (2024)
Computing	A software construct that autonomously performs tasks such as information retrieval, processing, or user interaction based on predefined instructions.	*Oxford English Dictionary* (2024); Chari et al. (2020)

Discipline	Definition	Source
Artificial Intelligence (AI)	A system or entity that makes autonomous decisions and performs tasks, often through algorithms or learning models.	Chari et al. (2020); Confalonieri et al. (2021)
Chemistry	A substance that initiates or facilitates a chemical reaction without being consumed.	*Oxford English Dictionary* (2024)

Definitions of "Ontology" Across Disciplines

Discipline	Definition	Source
Philosophy	The study of being and existence; focuses on categorizing what entities exist and how they relate to one another.	*Oxford English Dictionary* (2024); Hofweber (2023)
Information Science	An explicit specification of a conceptualization; used as a tool for knowledge representation and structuring information in computational systems.	Gruber (1993); Chari et al. (2020)
Artificial Intelligence (AI)	Frameworks that structure information and provide explanations for system outputs by modeling relationships between entities, system actions, and user interactions, thereby supporting explainable AI (XAI)	Chari et al. (2020); Confalonieri et al. (2021)

2. ***Reflect on Parallel Meanings:***

This stage focuses on identifying parallel meanings that terms carry across disciplines. The level of detail and specificity here may vary, and projects requiring a deeper understanding might need to further define how terms are used within each field.

Simplified Comparison of Terms Across Domains

Domain	**Agent**	**Ontology**
Law	A human acting with legal responsibility; subordinate to a principal.	Rarely used formally; might imply categorization of legal entities.
Philosophy	A being capable of intentional action and autonomy.	The study of being and existence, focusing on abstract entities.
Information Science/ AI	A software system possibly with autonomous decision-making capabilities.	A structured framework for modeling knowledge/ and generating explanations.
Potential Confusion	Legal scholars see an *agent* as a person, philosophers emphasize intentionality, while AI researchers emphasize an autonomous system.	Philosophers view *ontology* as abstract inquiry, while AI and information scientists focus on practical models for structuring knowledge.

Resolution	Clarify if *agent* refers to a human actor (legal), a conscious being (philosophy), or an autonomous system (AI).	Specify whether *ontology* refers to metaphysical discussions (philosophy) or computational/knowledge models (AI, information science).

3. **Examine Temporal Dimension in Parallel Meaning Contexts**

Agent

The term agent has evolved differently in each discipline, reflecting both continuity and shifts in meaning over time.

Philosophy

In philosophy, the concept of an agent has remained focused on intentionality and autonomy. Traditionally, an agent was seen as a being capable of acting independently, often in the context of moral and ethical responsibility. Today, this understanding persists, with discussions emphasizing free will and moral responsibility in addition to autonomy (Schlosser, 2019). In contrast, the law treats the agent's autonomy differently.

Law

The definition of an agent in law has remained relatively stable since the 19th century. It consistently refers to a person authorized to act on behalf of another, particularly in legal and business contexts. The core legal principle that an agent acts in the interests of a principal has persisted from earlier centuries to modern law. However, unlike philosophical agents who act based on free will, legal agents are bound by their contractual or fiduciary obligations, emphasizing representation over autonomy (“Agent,” 1910; “Agent,” 2024).

Computing

While the legal agent's authority is based on human relationships and contractual duties, the computing agent moves away from human actors altogether. The term agent first emerged in the 20th century to describe software entities capable of performing tasks autonomously. This definition has evolved into a more refined understanding, where software agents perform functions such as information retrieval, data processing, or user interaction, all without direct human intervention. Here, intentionality is replaced by task automation, driven by predefined instructions or algorithms ("Agent," Oxford English Dictionary, 2024).

Artificial Intelligence (AI)

The concept of an agent has developed further in the 21st century in artificial intelligence (AI) research, where agents are now described as autonomous systems capable of decision-making and task execution. These agents operate independently and often use algorithms or machine learning to achieve their goals (Russell & Norvig, 2020).

Chemistry

In chemistry, the term agent refers to a substance that initiates or facilitates a chemical reaction without being consumed in the process. This specific application of the term has remained stable in modern chemistry. Unlike other fields where the term has evolved to encompass technological advances, in chemistry, the concept remains tied to physical and predictable reactions, with no connection to autonomy or decision-making ("Agent," Oxford English Dictionary, 2024).

Ontology

Philosophy

Ontology has its roots in metaphysics as the branch of philosophy concerned with the nature of being and existence. Aristotle's Metaphysics laid the groundwork for ontological inquiry, focusing on the categorization of entities

and the relationships between different kinds of beings. Ontology, in this classical sense, involves the study of what exists and how entities can be categorized based on their properties and relationships (Oxford English Dictionary, 2024; Hofweber, 2023). This abstract inquiry stands in contrast to its more applied meaning in information science and artificial intelligence research.

Information Science

In information science, the term ontology evolved in the 20th century to refer to formalized systems for structuring and representing knowledge. Thomas Gruber (1993) defined ontology as "an explicit specification of a conceptualization," highlighting its role in creating frameworks that enable machines to process and interpret domain-specific knowledge. Unlike philosophical ontology, which deals with abstract categories of existence, information science focuses on practical representations of relationships between concepts for the purpose of improving communication between machines.

Artificial Intelligence (AI)

More recently, ontologies in artificial intelligence (AI) have evolved from frameworks primarily used for structuring information into tools that also provide explanations for system outputs. For example, in explainable AI (XAI), ontologies enable systems to map decisions back to underlying data models. This allows users to trace a system’s reasoning and understand why certain outcomes were reached, making opaque AI systems more transparent. By organizing relationships between data, ontologies help break down complex machine-learning models into understandable components, offering insights into decisions that would otherwise remain inaccessible (Chari et al., 2020; Confalonieri et al., 2021). Thus, ontologies have transitioned from abstract categorizations of knowledge to systems that serve as mechanisms for generating explanations.

Versioning Structure

A versioning structure or timeline can help situate definitions within the current literature. Meanings evolve over time and are shaped by the body of scholarship in which they are used, making this a dynamic process. As key terms like *agent* and *ontology* shift in response to technological and academic developments, revisiting and adjusting frameworks may naturally become necessary, particularly when more detailed definitions are needed to align with the evolving focus of interdisciplinary projects.

For example, as shown in the evolution of *agent* and *ontology* across philosophy, law, computing, and AI, terms undergo significant transformations to reflect the demands of the respective fields in which they are employed. The nature of their semantic change underscores the need for an adaptable, versioning approach to definitions that keeps pace with evolving scholarship. As disciplines interact, particularly in interdisciplinary projects, the ability to track these changes through versioned frameworks will allow for more precise alignment of terms, ensuring that new meanings are integrated without sacrificing clarity.

Future Work

Looking forward, a formalized versioning system for tracking the semantic changes of key terms across disciplines could significantly enhance interdisciplinary communication and research. While resources like the Oxford English Dictionary already track the historical evolution of words, we propose a more targeted system focused on key terms relevant to specific collaborative fields. This system would allow researchers to establish a timeline of definitions and their evolutions, helping them better position their work within broader academic conversations. This versioning tool would improve clarity and consistency across disciplines by aligning term usage with current trends while also recognizing their historical contexts.

By formalizing this versioning approach, future research can create a dynamic, adaptive framework for monitoring semantic evolution, allowing scholars to track how terms evolve across time and disciplines. This system would help maintain clarity in rapidly advancing fields like AI and ensure that historical concepts and

ontologies remain integrated and relevant as they adapt to new technological and academic developments.

Conclusion

In the ever-evolving landscape of interdisciplinary research, the meanings of foundational terms like *agent* and *ontology* are constantly shifting. As technological advances and academic developments continue to reshape these terms, researchers face increasing challenges in maintaining clarity and consistency across disciplines. By employing metacognitive frameworks and developing a versioning system to track semantic changes, scholars can ensure that their work remains relevant and aligned with contemporary scholarship. This approach will enhance communication and collaboration across fields like AI, law, and philosophy and safeguard the historical integrity of key concepts as they adapt to new contexts. As interdisciplinary work becomes more prominent, tools that track semantic evolution will be critical to maintaining a shared understanding across disciplines, ultimately improving the quality and precision of academic research.

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