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The incommensurability problem

A critique of phenomenal structuralism

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Abstract

Phenomenal structuralism marks a significant shift in the study of consciousness, emphasizing the relational properties of experiential qualities rather than their intrinsic properties. This approach highlights how subjective qualities are organized and related, proposing that these structural relationships individuate such qualities within a multidimensional space.

This paper focuses on the core tenets of phenomenal structuralism, particularly its commitment to holism, and the challenges it poses for comparing experiences both between and within subjects. These challenges cast serious doubt on whether similar qualitative experiences are possible across different individuals or over time. This issue is especially concerning in cases like pain, which has important ethical implications. While phenomenal structuralism successfully illuminates the relational nature of qualities, it fails to adequately account for shared aspects of qualitative experience and the possibility that different sets of qualities might lead to the same discriminations. The paper concludes by considering alternative approaches, such as representationalism, which might preserve the strengths of phenomenal structuralism without its problematic consequences. This critique calls for further investigation into how qualitative experiences can be rigorously understood without invoking intrinsic properties in mental states.

Keywords: Consciousness • Holism • Phenomenal structuralism • Qualitative similarity • Representationalism

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1 Introduction

Conscious states are a particular kind of mental states characterized by *what it is like to have them*, commonly referred to as *phenomenal character*. This phenomenal character consists of various subjective qualities, such as the *redness* of the experience one has when looking at a ripe tomato, the *bitterness* of tasting coffee, the *painfulness* of a headache, or the *sharpness* of hearing a shrieking sound (Chalmers, 1996; Kriegel, 2009). These qualities form the building blocks of our conscious experiences, creating the diverse sensations and perceptions that shape our mental lives. A key challenge in explaining phenomenal character is determining what qualifies a state to possess it. This challenge can be divided into two related questions: explaining the differences in phenomenal character between states and understanding the conditions under which consciousness arises, irrespective of specific phenomenal character (Kriegel, 2009; Levine, 2001). In other words, if qualities are solely responsible for differences in phenomenal character among experiences, we must ask what allows a state to have qualities and what makes these qualities subjective or conscious.

Phenomenal structuralism addresses the first question, emphasizing that qualities are the features responsible for the differences and similarities between conscious experiences and proposing that these relations of differences and similarities constitute the entirety of what qualities are.

This theoretical framework represents a significant shift in the study of consciousness, offering a framework that emphasizes the relational properties of experiential qualities over intrinsic properties. This approach seeks to understand the subjective qualities present in our conscious experiences by analyzing the structural relationships between these qualities within a multidimensional space, providing insights into how they are organized and individuated. By focusing on the relational aspects, phenomenal structuralism provides a systematic framework for examining the complex patterns and connections that constitute the qualities in our conscious experience.

Phenomenal structuralism is inherently committed to phenomenal holism, which posits that the individuation of qualities cannot be understood in isolation but must be considered within the entire network of qualities. This holistic approach implies that any change in the relational structure of this network results in changes to the experienced qualities themselves. Proponents of phenomenal structuralism, like Fink, Kob, and Lyre (2021), acknowledge the challenges that holism presents, particularly given its controversy in other domains, such as theories of mental content. However, they argue that while holism may be contentious in those areas, it is highly plausible in the context of phenomenal qualities, as it underscores the dynamic and interconnected nature of conscious experience.

Despite this defense, this paper argues that phenomenal holism is particularly problematic in the qualitative domain, not because it precludes the possibility of different systems having experiences with the same phenomenal character, but because it predicts that qualities in different systems, or within the same system at different times, are incommensurable. This incommensurability hinders the ability to establish a comparison class between the qualities of different systems, thereby obstructing the meaningful and necessary intersubjective and intrasubjective comparisons.

For this purpose, the following section offers a comprehensive overview of the various versions of phenomenal structuralism, highlighting the distinct approaches and their respective scopes within the framework. Following this, section 3 will address the primary challenge to phenomenal structuralism, focusing on the incommensurability of qualities across different systems or temporal states. Finally, section 4 will synthesize the key points, assess the arguments' implications, and explore potential alternatives that retain the valuable insights of phenomenal structuralism while avoiding its pitfalls and not committing to the postulation of intrinsic properties in mental states.

2 Phenomenal structuralism: An overview

This section examines the foundational aspects of phenomenal structuralism, including its central claims and the distinction between metaphysical and empirical approaches. It also addresses the differences between modality-specific and modality-general perspectives on how qualities are organized and individuated. Furthermore, the section explores how quality spaces are constructed using methodologies such as Just Noticeable Differences (JND). It also examines how certain ideas in phenomenal structuralism are endorsed by other popular theories like Integrated Information Theory (IIT).

The emphasis on structural relationships between experiential qualities is at the heart of phenomenal structuralism. This perspective contrasts with traditional views that attribute fixed, intrinsic properties to qualities, determining their identity independently of other qualities. Phenomenal structuralism shifts the focus from the intrinsic nature of individual qualities to the patterns of similarities and differences between them. It presents a compelling framework in the philosophy of mind by offering a distinctive approach to understanding consciousness exclusively through the relational properties of experiential qualities.

According to phenomenal structuralism, the identity of a quality is determined by its position within a relational structure. Thus, the individuation of qualities involves identifying the unique position of each quality within a network of relationships that define its similarities and differences to other qualities. In this framework, we can think of qualities as nodes within a graph where each node represents a specific quality, and the edges between nodes represent the relations of similarity or difference between them. Alternatively, qualities can be conceived as points within a multidimensional space, where each point represents a specific quality, and the dimensions represent the various aspects of similarity and difference between them.

To illustrate, consider the quality of *redness*. Traditionally, one might think of redness as an intrinsic property of some states. However, in a relational framework, it can be understood by its position within the color space: it is perceived as closer to orangeness than to blueness and is opposite to greenness within this network. This relational understanding allows redness to be identified by its connections to other colors qualities, emphasizing how it is perceived relative to them.

Phenomenal structuralism has been endorsed and defended by theorists such as Clark (2000) and Rosenthal (2005, 2015), who emphasize the importance of relational properties in defining experiential qualities. Additionally, Fink, Kob, and Lyre (2021) and Lyre (2022) have advocated for this view within the context of neuroscientific research. Separately, the Integrated Information Theory (Albantakis et al., 2023; Oizumi et al., 2014), embraces core ideas of phenomenal structuralism in the search for the physical substrate of conscious experience, particularly in the individuation of qualities within the experience.

By focusing on relational properties, phenomenal structuralism provides a flexible framework that accommodates the variability and complexity of conscious experience. This relational framework enables a comprehensive analysis of how experiences vary across individuals and contexts, capturing the details and complexities of how we perceive the world (Fink et al., 2021).

2.1 Modality-specific vs. modality-general approaches

Within phenomenal structuralism, two approaches can be distinguished based on how they treat the individuation of qualities: modality-specific and modality-general.

Modality-specific phenomenal structuralism holds that qualities are individuated within specific sensory modalities, such as vision, audition, or olfaction, or even within a more restricted domain like color perception.[1] This approach suggests that each sensory modality has its own distinct quality space, where qualities are individuated by their relational properties within that space. For instance, in the context of color perception, qualities like redness or blueness are distinguished based on their relationships within the color space. This space is characterized by dimensions such as hue, saturation, and brightness in the HSB model or by lightness, a* (green-red), and b* (blue-yellow) in the CIELAB model.

[1] E.g., Rosenthal (2015).

Research in psychophysics is typically modality-specific, enabling a detailed analysis of how qualities are perceived and organized within each sensory domain. This approach captures the unique characteristics and relational dynamics of qualities specific to each modality.

However, this modality-specific approach faces a fundamental tension: it assumes modality boundaries before establishing their relational structures, thereby violating structuralism's core commitment to purely relational individuation. According to phenomenal structuralism, qualities are individuated solely by their relationships to other qualities. If we restrict ourselves to one sensory domain, qualities are not exclusively individuated by their relational properties but also by the domain they belong to. This means that qualities such as redness or pitch are not just defined by their position in a relational network but are also inherently tied to the modality of vision or hearing, respectively.

Qualities in one modality are not isolated from other modalities, and it is often possible to establish comparisons between qualities across different sensory domains. For instance, the brightness of a color and the loudness of a sound can both be described in terms of intensity, highlighting a shared perceptual dimension across modalities. Similarly, the sharpness of a taste and the sharpness of a sound evoke comparable perceptual reactions despite belonging to different sensory modalities. Likewise, the emotional quality of grieving the loss of a loved one bears a closer resemblance to the painfulness of a stomachache than to a visual quality like redness. These systematic correspondences are not merely anecdotal but reflect a fundamental architectural requirement: such comparisons are only meaningful because qualities occupy related positions within a unified quality space. A strictly modality-specific approach cannot explain these patterns without tacitly relying on a multimodal space, since the very act of distinguishing modalities presupposes a shared framework that enables their comparison.

Modality-general phenomenal structuralism resolves this issue by proposing that qualities are individuated within a unified, cross-modal space encompassing multiple modalities. Within this space, modalities like vision or audition might be recovered through topological properties, for instance, the higher-dimensional connectivity among color qualities compared to their relations with sounds. These global relational patterns, not local clustering alone, would explain why color experiences naturally group together while remaining systematically comparable to sounds or pains. The modality-general perspective thus captures the interconnectedness of sensory experiences, offering a principled, holistic framework for understanding qualitative organization across consciousness.

2.2 Scientific vs. metaphysical approaches

A key distinction exploring phenomenal structuralism is between scientific and metaphysical approaches (Lyre, 2022). The scientific approach focuses on the empirical investigation of consciousness, aiming to map the relationships between qualities through experimental methods and data analysis. This involves constructing models of quality spaces using psychophysical tools, such as Just Noticeable Differences (JNDs) and multidimensional scaling, to understand how qualities are organized and perceived within a specific sensory modality. For instance, Fink, Kob, and Lyre (2021) propose a restriction in research on the neural correlates of consciousness by imposing the condition that neural activity should preserve the phenomenal structure (Q-structure). This means that neural structures must reflect the relational properties of experiential qualities as they are mapped in quality spaces. This approach seeks to narrow the gap between empirical data and experiential qualities by demonstrating that neural structures can reflect the same relational properties found in conscious experience.

The scientific approach emphasizes the importance of qualitative structure in understanding experiential qualities. This perspective acknowledges that structural facts, such as the relationships among qualities, can be investigated through scientific methods like psychophysics without requiring direct experiential access. These structural facts are considered objective because they can be known from science's objective point of view,[2] as they

[2] Lee (2024) defines *objective phenomenal facts* as aspects of conscious experience that can be understood from any point of view without direct experience. However, Lee suggests that phenomenal facts may have degrees of objectivity depending on the range of points of view from which they can be understood.

describe the organization of experiences rather than their intrinsic nature. However, scientific phenomenal structuralism allows for the possibility of additional features, including intrinsic ones, that contribute to the individuation of qualities. Thus, while structural facts provide a framework for scientific inquiry, it is open to the idea that it may not fully capture the entirety of qualitative experience and that some aspects of consciousness remain beyond the grasp of purely structural understanding.

In contrast, the metaphysical approach explores the fundamental nature of qualities and their individuation without necessarily relying on empirical data. This approach addresses more profound philosophical questions about the essence of qualities and the nature of consciousness. It denies that qualities can exist independently of their relational structures and holds that they are fundamentally defined by their positions within a quality space. Some form or other of metaphysical phenomenal structuralism has been defended or endorsed by Albantakis et al. (2023), Clark (2000), Lyre (2022), Oizumi et al. (2014), Rosenthal (2005, 2015). This paper targets this metaphysical approach.

2.3 Constructing quality spaces: JNDs and IIT

The construction of quality spaces is a central aspect of phenomenal structuralism, providing the framework for understanding how qualities are individuated and organized. A primary motivation for phenomenal structuralism is to examine the relations of difference and similarity among experiences. This examination facilitates empirical research on qualities and tracks their fundamental nature according to the metaphysical approach. One classical method used in this research is the already mentioned Just Noticeable Difference (JND) approach, which measures the smallest perceptual difference a subject can detect between stimuli. This psychophysical method helps to map out quality spaces by identifying the relational structure of experiential qualities.

In addition, phenomenal structuralism is endorsed by theories like Integrated Information Theory (IIT), where qualities are individuated by their location within a specific structure, known as the Φ-structure. Unfortunately, computing the Φ-structure in any real system is not feasible due to the computational complexity involved. This epistemological constraint does not *per se* diminish its potential metaphysical interest, and I will discuss its limitations independently. However, it is worth noting that some proponents of IIT[3] also advocate for psychophysical approaches to study the relational properties of qualities, hoping that behavioral responses reflect the underlying structure that individuates qualities according to the theory.[4] Let us briefly review the construction of quality spaces with JNDs and in IIT.

The quality space can be constructed from JNDs, the smallest perceptual differences detectable by an observer, which serve as basic units for measuring the discriminability between sensory stimuli. However, pairwise discriminations alone are insufficient for ordering experiences meaningfully. Similarity ratings, which help organize experiences by arranging them based on perceived similarities and differences, are used to create a coherent structure. An early example is the color wheel, which originated in the 17th century with Newton's work, where colors are arranged in a circle, reflecting their natural ordering in phenomena such as the rainbow. This circular arrangement illustrates how the perceptual system transforms a linear spectrum of colors into a compact, continuous representation, where the ends of the visible spectrum, violet and red, are joined by shades of purple (Lyre, 2022).

In constructing color spaces, perceptual dimensions such as hue, saturation, and lightness are used to organize colors into perceptual spaces. By mapping out the relational structure of experiences within each modality, a specific quality space (Q-space) can be created, allowing us to explore the organization of sensory qualities systematically.

While this methodology is highly effective within individual sensory modalities, extending it to create a modality-general space is challenging.

[3] E.g., Kawakita et al. (2024).

[4] According to IIT, consciousness can be completely dissociated from behavior, and there is no principled reason to link consciousness to neural activity or subjects' reports recorded in psychophysical studies. Nonetheless, both assumptions are often made in scientific studies related to IIT.

However, no fundamental limitation prevents such an expansion, suggesting that it is possible to develop a unified framework that spans multiple modalities with further research.

Integrated Information Theory (IIT) offers a distinct, yet potentially complementary, approach to understanding the construction of quality spaces in consciousness research. According to IIT, consciousness arises from a system's ability to generate integrated information, quantified by a measure called 'phi' (Φ). This measure is calculated by partitioning the system into subsystems and assessing the loss of information when these subsystems are treated independently. This process involves defining a cause-effect structure for each state, which evaluates the interdependencies among the system's causal units.

In IIT, the qualities of a conscious experience, such as the *redness* or *roundness* perceived when looking at an apple, are determined by how the system causal units interact to constrain both future and past states.[5] Specifically, these qualities are defined by the system's current cause-effect structure: the so-called Φ-structure. This structure represents the network of causal relationships within the system, capturing how the causal units work together (integration) and how they are differentiated from one another (differentiation).

The Φ-structure can be visualized as a network of points, where each point corresponds to a specific unit, representing a unique activity configuration. Nodes in this network are defined as phenomenal distinctions – specific cause-effect states that are influenced by past states and capable of influencing future states – corresponding to the most fundamental qualities; i.e. features that make a difference in phenomenal character. Connections between these nodes, represented as edges in the network, indicate the relationships between different cause-effect states, showing how one element can transform another or share common features. This interconnectedness captures the qualitative relationships between elements, illustrating their causal similarities and differences.

Unlike traditional structuralist approaches that define qualities through their relations to other possible qualities not necessarily present in the experience, IIT adopts a distinct framework. In IIT, the overall phenomenal character of the experience is determined by the Φ-structure, while component qualities (e.g., blueness, loudness) correspond to specific features of such a structure, the specific configuration of causal distinctions and relations present at that moment. Distinctions and relations are individuated entirely by their relationships to other nodes within this momentary structure, aligning with the principle of phenomenal structuralism. Importantly, a different Φ-structure is assigned to the system over time, corresponding to phenomenal differences (qualitative changes) that a system undergoes at different moments.

[5] For a comprehensive technical treatment of IIT's framework, including its quality space formalism, see Oizumi et al. (2014); Albantakis et al. (2023).

3 The challenge of holism: Incommensurability in phenomenal structuralism

Despite its appeal, phenomenal structuralism faces a significant challenge that, as I argue, seriously undermines its viability. The core of this challenge is as follows: According to phenomenal structuralism, the individuation of qualities depends solely on their position within a specific Q-structure, which is determined by the unique constraints of a particular system, or even of that system at a particular time. As a result, the qualities of experiences across different individuals, or even the same individual at different times, become incommensurable. However, intra-subjective and inter-subjective comparisons of qualities are essential to our understanding of phenomenal qualities and their roles in explaining other's behavior and reasons. If we are to preserve the possibility of such comparisons, then (metaphysical) phenomenal structuralism fails to provide a plausible account of qualities.

The fact that qualities are individuated by their location in a Q-structure means that all there is to a quality is its position within this structure, and the relations to other qualities within such a structure entirely define the quality in question. This view is inherently committed to holism: the structure as a whole determines each internal *relatum*. This holistic approach is not unique to the phenomenal domain but is also endorsed in other fields. For example, in psychosemantics, inferentialism is a theory that proposes that the content of a mental representation is determined by its place within a web of inferences and its relations to other mental representations rather than by any intrinsic properties or direct reference to objects in the world. According to inferentialism, the content of a representation is not isolated but is instead defined by its inferential relationships to other representations (e.g., Block, 1986; Brandom, 2000). Inferentialism has been severely criticized for this holistic consequence. The critique primarily centers on the idea that if a subject acquires a new representation, such as a new concept, it modifies the meaning of all the concepts the subject holds (Fodor & Lepore, 1992; Cf. Block, 1998).

In the phenomenal case, this means that introducing a new quality, losing any experiential capacity, or altering existing relationships affects the entire network, causing a reconfiguration of the quality space and changing how qualities are individuated within it. In other words, even minor changes completely transform the qualities of a subject's experiences. As a result, two subjects can only share a quality if they have exactly the same experiential capacities. That is, there can be no shared quality between two subjects' experiences unless they share all experiences and possess the exact same set of qualities that underlie the same discrimination capacities.

Fink, Kob, and Lyre (2021) acknowledge this consequence but argue that these arguments against psychosemantic holism have no force when it comes to holism about phenomenology. In fact, they suggest that we should expect considerable variability in the individual Q-structure even among members of the same species. They argue that this variability in Q-structure is not only expected but also supported by empirical evidence, particularly in the case of color perception. For instance, the individual differences observed in color perception among humans demonstrate that how colors are experienced can vary significantly. Individuals differ not only in the composition of their retinas but also in the size and connectivity of their visual cortices, resulting in differences in the color judgments people make in everyday situations (Hofer et al., 2005). In individuals with color blindness, particular color distinctions apparent to others are not perceived at all, leading to a fundamentally different color experience.

On the other hand, tetrachromats, who have an additional type of cone cell in their retinas, can perceive a broader range of colors than most people, leading them to experience colors in a richer and more nuanced way. Fink, Kob, and Lyre argue that these differences mean that color experiences are not merely shifted or altered but are fundamentally different in their qualitative structure. This variability underscores their point that holism about phenomenology is not a flaw but a reflection of the true nature of experiential qualities. They argue that, unlike in psychosemantics, where holism might be seen as problematic due to its implications for communication and understanding, in the realm of phenomenal experience, such variability is expected and even welcomed as a natural consequence of the relational nature of qualities.

I disagree, and I will present a challenge that does not stem from the fact that subjects with different experiential capacities might perceive different qualities when exposed to the same stimuli (due, for example, to retinal or neural differences). Instead, the issue lies in that, according to phenomenal structuralism, such qualities become incommensurable.

To illustrate why this is particularly counterintuitive, consider Frank Jackson's (1982) well-known thought experiment. In this scenario, Mary, a scientist who knows everything about color from a scientific perspective, is confined to a black-and-white room. She wonders what it is like for others to see the color red. According to Jackson, this uncertainty is resolved when Mary is finally freed and sees red for the first time.

This thought experiment is built on two key intuitions. The first, more controversial intuition is that even with complete scientific knowledge, Mary would still lack the experiential knowledge of what it is like to see red. Phenomenal structuralism, like many other physicalist theories, rejects this idea. Mary would have no difficulty, even inside the room, in coming to know the Q-structure of any subject. Through this, she would understand all the relations within that structure corresponding to the color qualities a subject might experience, including what it is like for them to see red.

This could even include her own potential experiences, by analyzing the relations to the underlying neural structure before actually having them.

However, there is a second intuition, typically regarded as less controversial, which suggests that a normal perceiver can gain an understanding of the experience another normal perceiver of their own species has when Ψ-ing (e.g., seeing red) just by Ψ-ing. Phenomenal structuralism has to reject this intuition as well. The theory posits that if two subjects differ even slightly in their experiential capacities, they will have different Q-structures. Consequently, the qualities they experience are not just different but fundamentally unrelated. This implies that shared experiential understanding is impossible if the underlying Q-structures differ, a conclusion that challenges common sense.

Beyond intuitions, the core challenge I intend to present is that qualitative comparisons, which phenomenal structuralism renders impossible, are crucial for behavioral explanations, empathy, and moral intuitions. This problem is especially pressing in the context of IIT, as IIT does not provide a phenomenal interpretation of the distinctions and relations other than stating that Φ-structure is identical to the system's experience (cf. Kleiner, 2024). As a consequence, IIT struggles to identify similar qualities across different experiences, even within the same subject. With this in mind, I will begin by examining this particular case.

In IIT, as discussed, the identity of the qualitative distinctions, that underlie ordinary qualities like redness or painfulness, depends solely on their location within a Φ-structure, which is determined by the system's specific state. This Φ-structure determines the resulting experience. However, a significant problem arises when we consider the need to recognize common or at least similar qualities across experiences that correspond to vastly different Φ-structures. Such common qualities are often crucial for explaining behavioral patterns, such as similarity judgments.

Consider the following two scenarios:

1. You are staring at a red ganzfeld in a soundproof room.

2. You are walking through a humid and hot forest and notice a bright red bird perched on a low branch. Amid the natural environment's multitude of colors and forms, the bird's vivid feathers catch the sunlight, making them stand out as the most striking feature in the otherwise green landscape.

These two experiences share a similar quality related to the color red, which might explain, for example, similarity judgments or why the color of the bird reminds you of the red *ganzfeld*.

The experience is relatively impoverished in the first scenario, corresponding to a simple Φ-structure with few distinctions and relationships. The second scenario, by contrast, entails a richer experience requiring a far more complex Φ-structure with numerous distinctions and relations. Given IIT's holistic commitment, where qualitative distinctions are individuated entirely by their position within a specific Φ-structure, qualities in these situations become incommensurable. There is no principled basis for mapping nodes from the simple Φ-structure onto the complex one, nor for establishing similarity relations between their respective qualities, even when the experiences seem to share common features.

One possible solution is to appeal to topological similarities between different Φ-structures, assuming that color qualities correspond not to fundamental distinctions but to more complex substructures, or to some matching relation with environmental features (Albantakis et al., 2023). However, the problem remains, as IIT offers no criteria for determining which topological relations among the many that hold between structures constitute genuine qualitative similarity, or which environmental correspondences (if any) are relevant.[6] Without such metrics, the theory cannot ground intersubjective or intrasubjective comparisons across divergent

[6] Kleiner (2024) questions the assumption that a structure-preserving mapping exists between the phenomenal and physical domains. The core problem, however, goes beyond this: if substructural similarity is determined solely through local structural mappings, multiple possible correspondences arise, with no principled way to identify the one that accurately reflects the required qualitative similarities. Furthermore, invoking behavioral resemblance is unhelpful in this context, as IIT maintains that it does not provide a reliable indicator of qualitative similarity (fn. 4).

Φ-structures, a significant limitation for explaining intuitive judgments of qualitative resemblance.[7]

Things do not improve when considering intersubjective experiences within modality-general phenomenal structuralism, regardless of whether we use IIT's framework or the JND methodology. The holistic commitments of phenomenal structuralism become very problematic, particularly when addressing specific types of experiences like pains.

As a holistic position, phenomenal structuralism suggests that individuals with different experiential capacities will experience different qualities. Consequently, the painfulness of a toothache you experience differs from mine. While it is reasonable to accept the differences, we might still assert that my toothache is more similar to yours than either of our toothaches is to our respective headaches. More clearly, our respective toothaches are more similar to each other than they are to experiences like seeing red or feeling pleasure. Any experience we categorize as pain, despite its variations, aligns qualitatively more closely with other pains than with not-painful experiences, like for example, an orgasm.

However, phenomenal structuralism struggles to account for this. The theory asserts that qualities cannot be compared across different qualitative structures, making it impossible to claim that my painfulness and yours are similar.

One might attempt to compare our Q-spaces structurally by identifying common dimensions, such as intensity, sharpness, burningness, and tinglingness.[8] Yet, how these structural features individuate a quality as painful remains unclear. For example, we can easily conceive of creatures whose pains lack a burningness dimension or have entirely different sensory modalities. Consider a bat:[9] Even if we could fully understand its Q-space through JNDs or its Φ-structure, we would still wonder whether any of the nodes in these structures correspond to a painful experience. This would require establishing some comparison between the bat's qualities and ours since any experience worth being considered pain must be more similar to our pains than to its echolocating experiences, regardless of how the latter feel.[10]

Taking this idea further, imagine a conscious being that only perceives body pressure variations and magnetic fields. We would naturally wonder whether such a creature experiences pain when there is a particular change

[7] Haun & Tononi (2019) investigate the correspondence between the phenomenal experience of spatial extendedness and the physical properties of grid-like neural substrates. To do so, they analyze the introspectively accessible structure of spatial experience (e.g., relations like connection, fusion, and inclusion) and then identify analogous mathematical properties in the cause-effect structures of simulated grid networks using IIT. A similar approach is attempted for temporal flow in Comolatti et al. (in press). However, this methodology faces two significant challenges:

First, the strategy relies on introspectively decomposable phenomenal structures (e.g., spatial relations). For experiences that lack obvious internal structure, such as unitary qualities like specific redness or painfulness, the method offers no clear path to analogous mappings.

Second, and more importantly, the formalism of IIT lacks a theory-internal criterion to justify why specific mathematical properties of the Φ-structure correspond to specific phenomenal features (Kleiner, 2024). Without principled constraints, such mappings risk being *post hoc* or engineered rather than derived from first principles. Absent independent grounds for these identifications, the theory's explanatory power hinges on discovery rather than deduction. If, as some have argued (IIT-Concerned et al., 2025), the construction of the Φ-structure for real systems is not merely practically infeasible but impossible in principle, this would impose a fundamental limitation on the entire approach.

[8] For a proposal to compare qualities among different Q-structures of normal subjects, see, for example, Kawakita et al. (2024).

[9] As we have seen, phenomenal structuralism is neutral on the question of what makes a state conscious. For illustrative purposes, it is then safe to assume that a bat has conscious experiences.

[10] In reply to Fodor and Lepore (1992), Churchland (1998) argues that conceptual similarity can be established for systems with different internal structures that nonetheless perform the same categorization task, using metrics like the Guttman Point Alienation (GPA). While the GPA successfully addresses task-relative conceptual similarity, it fails to resolve the phenomenal incommensurability problem. The GPA presupposes a shared task (e.g., color categorization) to anchor comparisons, but pain and other states lack such a framework. Without a task-independent basis for aligning activation spaces, structural similarity (GPA's focus) cannot guarantee phenomenal similarity, which is the core issue in my argument. I am grateful to an anonymous referee for pressing me on this point.

in the magnetic field or body pressure.[11] If the creature does experience pain, that pain should naturally be more similar to our pain than to any of our pleasurable experiences. However, phenomenal structuralism renders these experiences incommensurable. Moreover, under phenomenal structuralism, the question of whether the creature can feel pain seems meaningless, as qualities are defined solely by the discriminations they elicit according to the JNDs methodology.

This consequence is more than merely counterintuitive; it would fundamentally undermine our moral judgments and alter our ethical decision-making considerations. Intersubjective comparison of qualities, particularly in the case of pain, is crucial for several reasons. First, ethical considerations are paramount: understanding whether different beings, such as non-human animals or patients in vegetative states, experience pain is essential for making informed decisions about their treatment and rights. This understanding is fundamental in contexts like clinical triage or the welfare of potentially conscious entities, such as artificial systems. Cross-species comparisons of qualities also inform conservation efforts and improve our interactions with other species by recognizing shared experiences. The justification for this idea relies on the principle that, all else being equal, it is wrong to cause pain to other creatures: we should avoid causing states in others that are of the same kind as the pain we experience, with the kind being determined by qualitative similarity.

One might respond by rejecting the modality-general form of phenomenal structuralism in favor of a weaker version restricted to a specific modality in such a way that it is the modality that determines whether a specific quality is painful. However, as we have discussed, this move undermines the broader rationale that initially supported phenomenal structuralism: individuating qualities solely by their structural properties. Moreover, even within a restricted modality, such as color perception, it is implausible to suggest that qualities are individuated solely by their relations to other qualities within a particular Q-structure, such as those determined by JNDs.

For this purpose, consider the specific Q-structure of a subject S at a certain point in their life as modeled by the CIELAB color space. The CIELAB model provides a standardized representation of color using three coordinates: L*, a*, and b*. L* corresponds to lightness, capturing the brightness of the color. Instead of using hue directly, CIELAB represents chromaticity with a* (the green-red axis) and b* (the blue-yellow axis). Negative a* values indicate green, while positive values indicate red; negative b* values indicate blue, and positive values indicate yellow.

If the brain processes color information by comparing responses from cones sensitive to different wavelengths, then the position of a color along the a* axis depends on comparing inputs from the L (long-wavelength, red-sensitive) and M (medium-wavelength, green-sensitive) cones. Similarly, the b axis involves the S (short-wavelength, blue-sensitive) cones, contrasted with combined signals from the L and M cones.

Imagine a scenario where a subject, S, suddenly develops a condition where the comparator responsible for determining values along the a* axis becomes fixed, yielding the same output regardless of stimulus differences. As a result, S would lose the ability to discriminate between colors that differ only in their red/green component, the CIELAB Color Difference (ΔE*), which measures perceived color differences, would be zero for those stimuli. Despite this loss of discrimination along the red-green (a*) axis, S's ability to perceive variations in the other two dimensions would remain intact, as these are processed by different neural mechanisms.

Phenomenal structuralism naturally predicts a change in the color qualities experienced by S before and after the condition's onset. With the loss of the red-green (a*) dimension, S would now experience a different set of color qualities within a two-dimensional color space that does not directly correspond to the previous three-dimensional color space. Nevertheless, if the comparator is fixed at a positive value, S would likely perceive all colors that would normally vary along the red-green axis as having a stronger red component, making them more similar to previous qualities with a

[11] The question is more pressing in the particular case of IIT. According to IIT, most real systems are conscious to a greater or lesser degree depending on the number of distinctions and relations. Regardless of the problems derived from such panpsychism consequences, we care whether a conscious system is in pain. It seems that IIT cannot provide an answer.

higher a* value than to those associated with a lower a* value. In other words, while the overall color perception would be altered, the nature of the alteration – whether colors appear more red or green – would depend on the fixed direction of the comparator, retaining some resemblance to past experiences. However, according to phenomenal structuralism, this resemblance does not hold.

Under phenomenal structuralism, the Q-space of subject S before and after the condition is significantly different due to the loss of an entire dimension. Despite this, it seems natural to think that some old qualities would still resemble the new ones more than others. For instance, one might wonder which pre-condition qualities, based on their a* values, most closely resemble the post-condition qualities. The problem arises when qualities are defined solely by their relations within the Q-space, based on the discriminations the subject can make, independent of the comparator's fixed value. According to this view, there is no way to determine which plane of the original three-dimensional Q-space most closely matches the two-dimensional structure of S after the condition, as there are infinitely many possible ways to map the post-condition 2-D structure onto the pre-condition 3-D one. This conclusion is troubling because it implies that S would be unable to make any meaningful comparisons regarding color before and after the condition.

Even if we accept that S can make such comparisons and use them to relate the new space to the old one, this approach does not extend to the intersubjective case. The example demonstrates that different sets of qualities can indeed yield the same discriminations within a single modality, such as color. For instance, different sets of post-condition qualities that resemble pre-condition qualities with varying a* values would still allow for the very same discriminations along the other two dimensions. If this holds true, qualities are not solely individuated by their location in a Q-space determined by JNDs.

4 Conclusion

Defenders of phenomenal structuralism acknowledge its holistic nature and argue that the objections raised against psychosemantic holism do not apply similarly to holism about phenomenology. They contend that the variability in individual Q-structure, even among members of the same species, is expected and reflects the true nature of experiential qualities. These differences, they argue, underscore the relational nature of qualities and reinforce the holistic perspective that phenomenal structuralism advocates.

However, this paper suggests that the theory's commitment to holism leads to significant challenges. Phenomenal structuralism posits that the qualities we experience are entirely determined by their position within a specific Q-structure, which is shaped by the unique constraints of a particular system, or a particular state of a system in IIT. This commitment to holism implies that even minor differences in experiential capacities lead to fundamentally different Q-structures, rendering qualities incommensurable across different systems or even across different states within the same system.

This incommensurability raises significant concerns, particularly regarding our ability to make inter-subjective – and even intra-subjective – comparisons of qualities. Such comparisons are crucial for understanding phenomenal qualities and their roles in understanding other subjects. If we accept the premises of phenomenal structuralism, it becomes difficult, if not impossible, for different subjects to have experiences of the same kind, when belonging to a kind requires a certain degree of qualitative similarity. This issue is especially pressing in the case of pain, which is central to moral considerations.

The complexity deepens when we consider our intuitive understanding of qualities. A key component of our notion of qualities is that the same discriminations along specific dimensions can be made by different sets of qualities that are structurally identical but differ along another dimension. The example discussed earlier suggests that it is possible to have two sets of color qualities that allow for the same discriminations in luminosity

(L*) and the blue-yellow component (b*). Yet, these two sets correspond to different values of the red-green component (a*), effectively occupying different planes in the color space. If this is the case, it implies there is more to qualities than just the discriminations they enable within a particular system, challenging the idea that qualities are fully individuated by such discriminations alone (e.g., Lyre, 2022).

Some phenomenal structuralists, such as Fink, Kob, and Lyre (2021) contrast phenomenal structuralism with the idea that the alternative is to treat qualities as intrinsic properties. However, there are other alternatives worth considering. For instance, if we conceive of qualities in terms of their functional role – not individuated by similarity judgments but by the functions they serve within a system we can avoid committing to intrinsic properties while also steering clear of the pitfalls of phenomenal structuralism. The challenge here is determining what these functional roles might be. One potential solution comes from informational representationalist theories (e.g., Dretske, 1995; Shea, 2007), which links qualities with the information carried by experience, specifically, how conscious states reduce uncertainty by eliminating alternatives. On these views, qualities arise from the way experiences constrain possible states of the world and ourselves, enabling the establishment of similarity relations based on the similarity of their informational content. Notably, this remains neutral on the question of intrinsic properties. It neither assumes nor denies that qualities have intrinsic features, a question that hinges on whether the quality itself is necessary to specify the information provided (Chalmers, 2004). Moreover, it can offer insight into the broader question of what makes a state conscious (Sebastián, 2024a, 2024b).

Representationalism is compatible with the idea that qualities might represent through homomorphic relations (Shea, 2018) between representational and represented spaces (Rosenthal, 2015), which is closely aligned with the principles of phenomenal structuralism. However, representationalism is not restricted to this view. It also allows for the possibility that qualities can represent independently of their position within a Q-structure. This broader perspective helps explain how different systems experience similar qualities, even if their underlying structures differ.

In closing, it is essential to note that the challenges presented in this paper do not necessarily undermine a weak or methodological reading of phenomenal structuralism. It remains plausible that our cognitive system exploits homomorphic relations to make necessary discriminations and similarity judgments, which might, in turn, require neural structures that are homomorphic to the quality spaces they represent. However, caution is warranted. It is crucial to be aware of the potential pitfalls and explore other strategies that may underlie the capacity to make these discriminations and judgments. Future research should explore these possibilities, acknowledging phenomenal structuralism's strengths while addressing its limitations.

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