Extending Gurwitsch's Field Theory of Consciousness[*]

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Abstract: Aron Gurwitsch's theory of the structure and dynamics of consciousness has much to offer contemporary theorizing about consciousness and its basis in the embodied brain. On Gurwitsch's account, as we develop it, the field of consciousness has a variable sized focus or "theme" of attention surrounded by a structured periphery of inattentional contents. As the field evolves, its contents change their status, sometimes smoothly, sometimes abruptly. Inner thoughts, a sense of one's body, and the physical environment are dominant field contents. These ideas can be linked with (and help unify) contemporary theories about the neural correlates of consciousness, inattention, the small world structure of the brain, meta-stable dynamics, embodied cognition, and predictive coding in the brain.

Keywords: Gurwitsch; Attention; Inattention; Phenomenology; Neural Correlates of Consciousness; Embodied Cognition; Global Neuronal Workspace; Small World Networks; Meta-stable dynamics; Predictive Coding

The phenomenologist and psychologist Aron Gurwitsch defined the field of consciousness as a "totality of co-present data" (Gurwitsch, 1964, p. 2). In contemporary terms a field of consciousness is a phenomenal conscious state (Block, 1995) at an instant or over a brief duration.[1] The reference to a "totality of data" suggests a rich view of consciousness (Block, 2008; Hurlburt & Schwitzgebel, 2007), whereby conscious states at times have multiple parts: a person might be aware of a computer, a cup of coffee, rustling in another room, a mild stomach ache, etc. The reference to "co-presence" emphasizes that all these parts are *unified* in a single conscious state (Bayne & Chalmers, 2003; Brook & Raymont, 2014)**.** [2]

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[1] Dainton (2010) contrasts "retentionalist" and "extensionalist" models of temporal consciousness. On the retentionalist view, conscious states are instantaneous (though retained memories create an illusion of temporal extension) and so we can literally refer to a field of consciousness "at a time." On the extensionalist view conscious experiences actually spread out in time. In that case reference to a field of consciousness "at a time" is convenient shorthand for "over a brief duration." We are neutral on the issue.

[2] We use terms like "data", "content" and "constituent" to refer to mereological parts (Varzi, 2003) of conscious states. If a person is aware of both a computer and a coffee cup, then both are parts of her total conscious state and are in that sense "data", "contents", or "constituents". Two things should be noted. (1) This use of "content" is different from a standard contemporary philosophical usage, whereby a content of (for example) a perception is the *state of affairs represented* by that perception. We use "content" in the more literal sense of a mereological part. Siegel (2013) helpfully differentiates the "contents" of a bucket (a mereological part of the filled bucket; our sense); from the contents of a newspaper article (the things described by the article; the more standard contemporary usage). (2) In describing consciousness as having mereological parts, Gurwitsch endorses what has recently been called the "Experiential Parts Theory" view (Brook & Raymont, 2014), though the contrary position, the "No Experiential Parts Theory" allows (for example) "aspects" of consciousness, which are themselves "parts" in Husserl's broad and fairly subtle sense.

We will argue that Gurwitsch's account, once it has been trimmed of its more excessive claims, can be extended and used to enrich contemporary consciousness studies.[3] Gurwitsch's main contribution is to develop a detailed account of the *totality* of conscious experience, and to delineate its structure and dynamics; to develop, in his words, a theory of the "the articulation of the total field of consciousness and… the patterns and forms in which co-present data are organized with respect to each other" (Gurwitsch, 1964, p. 2). Others have studied questions relating to particular types of experience, e.g. inattention (Mack & Rock, 1998), perceptual gist (Oliva, 2005), and non-sensory experience (Bayne & Montague, 2011), but few have asked the broader question of how these and other types of experiences are organized with respect to one another. Moreover those who do study the structure of consciousness tend to emphasize focal awareness. Gurwitsch's account of the structure of consciousness encompasses focus *and* periphery, and attributes specific organizational structures to each. In considering questions about the structure of the total field, Gurwitsch engages in a task that has long been considered central to scientific inquiry, "carving nature at its joints"[4], but that has received little attention in consciousness studies. Gurwitsch also develops an account of the field's dynamics, of how the structures he identifies in the total field change their status over time.

Gurwitsch's theory of the field of consciousness and its organization in to parts can be related to an equally rich theory of neural activity and *its* organization in to parts. Thus we have two parallel fields, with parallel part-structures. Others have considered the neural correlates of focal consciousness, but there has been little discussion of the neural correlates of non-focal consciousness, or of how structure and dynamics are related in the two domains. Insofar as there has been work on these questions, we argue that it can be profitably organized around Gurwitsch's theory.[5] We will see that the holistic interconnectedness of the phenomenal field can be associated with the dense "small world" coupling of the neural circuits which support it, that the distinction between smooth and abrupt field transitions can be associated with degrees of prediction error in internal statistical models, and that the variable sized focus can be associated with degrees of neural enhancement of the activation supporting focal awareness. These and other parallels can be visualized in computer simulations.

In section (1) we describe the main events of Gurwitsch's intellectual development, including his early work in Germany and his flight from the Nazis, which brought him in contact with a wide range of Continental and American thinkers. We also clarify his relationship to previous theorists, and comment on his phenomenological method. In section (2) we summarize

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[3] For a detailed interpretation and elaboration of Gurwitsch's theory, which (like us) considers it in relation to current empirical evidence, see (Arvidson, 2006).

[4] The phrase originates in Plato's *Phaedrus*. Plato compares the correct division of nature to a butcher properly carving meat. A similar theme occurs in Taoist lore: cut the meat "by the natural openings" and a knife won't need sharpening (Campbell, O'Rourke, & Slater, 2011).

[5] Some relevant lines of research we will not consider here include: (1) Tononi and Edelman's (1999) account of consciousness in terms of information integration, which (in Gurwitschean terms) associates degrees of field complexity with information-theoretic properties of the neural circuits supporting it, and (2) Escobar's account of "quantized awareness" (Escobar, 2013), which is consistent with the idea that the conscious field has a complex structure that to some degree mirrors the structure of the neural activity supporting it.

Gurwitsch's field theory, emphasizing those features of his account that are most relevant to contemporary discussions. In section (3) we show how Gurwitsch's theory can be revised and extended, and used to advance contemporary work on consciousness and its neural correlates.

1.Gurwitsh's Life, Influences, and Method

1.1 Gurwitsh's Life

Aron Gurwitsch (1901-1973) studied mathematics, physics, philosophy and psychology in Germany, fled the National Socialists to France in the 1930's, and then moved to America in 1940, where he helped establish phenomenology as a field of philosophical research.[6]

Gurwitsch began his studies at the University of Berlin under Carl Stumpf, an early experimental psychologist (Stumpf's first lab, consisting of disassembled piano parts in a closet and tower attic, was set up not long after Wundt's (Boring, 1929)). Stumpf introduced Gurwitsch to the work of William James and later suggested he go to Freiburg to study with Husserl. At Freiburg, Husserl made a lasting impression on Gurwitsch. In fact, he decided to dedicate his life to Husserl's project, to become a "disciple forever":

> When the author made his first acquaintance with Husserl's philosophy… he was overwhelmed by the spirit of uncompromising integrity and radical philosophical responsibility, by the total devotedness which made the man disappear behind his work... It was the style of Husserl's philosophizing, painstaking analytical work on concrete problems and phenomena... that made the young student take the decision to devote his life and work to the continuation and expansion of Husserl's phenomenology—in a word, to remain a disciple forever, faithful to Husserl's spirit and general orientation, but at the same time prepared to depart from particular theories if compelled to do so by the nature of the problems and the logic of the theoretical situation (Gurwitsch, 1979, pp. xv–xvi).

From Freiburg, Gurwitsch went to Frankfurt where he studied under the neurologists Kurt Goldstein and Adhémar Gelb, who were "working with veterans at a special institute set up by the Prussian government for the investigation of the psychological aftereffects of brain injury" (Embree, 2010, p. 42). Gurwitsch noted that color amnesiacs could directly match color samples but could not name colors, and took this to support Husserl's distinction between qualitative and "categorial" equality (roughly speaking, seeing that two things look similar as opposed to recognizing that they are members of the same category). He describes it as a case where "essential ideas which Husserl developed…have been fully confirmed by the result to which Gelb and Goldstein have been led in their studies of brain injuries" (Gurwitsch 1979b, 359). He was also struck by the affinity between the Gestalt emphasis on faithful description of perception

[6] This biographical material closely follows (Embree, 2010). Also see (Grathoff, 1989). On Gurwitsch's role in establishing American phenomenology see (Embree, 1989).

and Husserl's method of "phenomenological reduction", whereby those studying consciousness begin by bracketing all their assumptions about (for example) the brain and simply describe things as they appear. Gurwitsch wrote his dissertation on the parallels between Husserlian phenomenology and Gestalt psychology, which was published in 1929.

With Husserl's help, Gurwitsch went on to work as an assistant to Mortiz Geiger (a student of Wundt and Husserl) at Götttingen, where he wrote a habilitation on the phenomenology of the social world. Gurwitsch's interest in the phenomenology of social structures deepened after he met Alfred Schutz, who is remembered by sociologists and some philosophers today for his synthesis of phenomenology and sociology. Gurwitsch and Schutz referred to themselves as "workers at two ends of a tunnel" approaching the same problem: how to integrate phenomenology with the sciences; in Gurwitsch's case psychology, in Schutz's, sociology.

In 1933, Gurwitsch began his flight from National Socialism, emigrating to France, where he lectured at the Sorbonne on Gestalt psychology, and began studying Piaget's work. He befriended the famous phenomenologist Merleau-Ponty, who went on to attend his lectures. Today there is a minor scholarly question about how much of Merleau-Ponty's work is due to Gurwitsch's (largely unacknowledged) influence (Pintos, Maria-Luz, 2007; Toadvine, 2001). Merleau-Ponty followed Gurwitsch in interpreting Gestalt psychology as implicitly phenomenological and learned about one of his most famous cases (a patient named "Schneider") from Gurwitsch.[7] Gurwitsch noticed his influence on Merleau-Ponty (and the paucity of credit), and told Schutz in a letter: "[it] makes me happy and sad simultaneously… I suppose that one must come to terms with one's *Fatum*, but when Spinoza demands that one love it, that is certainly going too far" (Grathoff, pp. 88-89).

Narrowly escaping the camps[8], Gurwitsch moved to America in 1940, where he lectured on physics, mathematics, and philosophy at Johns Hopkins, Harvard, Wheaton, and Waltham. He referred to himself as "climbing the mountain of cotton" during this period. He eventually obtained more secure employment at Brandeis, where he was a colleague of Hubert Dreyfus, known for his Heideggerean critique of cognitive science. He went on to secure a position at the New School for Social Research, the "University in Exile" (set up for refugee scholars in 1933), where he would remain until his retirement in 1971. At Harvard in the 1940s, Gurwitsch received a grant to study the work of William James and was given access to James' unpublished manuscripts. Gurwitsch wrote two papers on James based on this research, both of which describe connections between James's ideas and Husserl's.

It was in this period that Gurwitsch began weaving all of these sources into his magnum opus, *The Field of Consciousness*, which was published in English in 1957.[9] The text merges all

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[7] Gurwitsch had been directly involved in the Gelb and Goldstein studies, and reported unpublished details of these studies to Merleau-Ponty.

[8] In August 1940, Gurwitsch writes: "we were intended for the concentration camp… and instead of that one finds oneself in this roomy house, one sits on the porch and works on Sartre's theory of the ego" (Grathoff, 1989, p. 15).

[9] The publication details of *The Field of Consciousness* are complex. An early draft was written in French while Gurwitsch was in Paris in the 1930's, with the intention of publication in France (this text was posthumously

of Gurwitsch's prior influences into the unified theory of the structure and dynamics of consciousness that we describe in the next section.

1.2 Gurwitsch's Sources

Gurwitsch's overall method is Husserlian. He is focused primarily on the effort to provide rich, accurate descriptions of subjective conscious experience (more in 1.3), and draws on almost all of Husserl's concepts in developing his theory. His main contribution to phenomenology is his theory of the overall structure and dynamics of consciousness. Others before him, James in particular, had described the temporal structure of consciousness[10] and the distinction between an attentional nucleus and an inattentional fringe. Gurwitsch took himself to be advancing on James by adding a new "dimension" to the study of consciousness, an analysis of how relevant or connected field data are to one another. Experiences of focal thoughts about math are connected to dim thoughts of related information in a different way than they are to experiences of the body or the visual periphery. There is not just a single fringe-structure associated with focal awareness, but rather a tissue of relevance relations, connecting phenomenal data more or less strongly to each other. In the course of elaborating these ideas, Gurwitsch draws on the Gestalt psychologists (for an account of how attentional contents are structured) and Piaget (for an account of how organizational tendencies or schemata develop).

Gurwtisch's debt to James is especially prominent. Husserl had also been influenced by James (his copy of *The Principles of Psychology* was heavily marked, especially in three chapters: "The Stream of Thought", "Conception", and "Attention").[11] Gurwitsch took the interest further, writing several papers on James and working at the James archives at Harvard. He thought James had improved on the atomistic empiricist theory of consciousness, and credits James with emphasizing the temporal continuity of consciousness. Gurwitsch's theory of the "thematic field" is an elaboration of James' account of the fringe. Gurwitsch's field metaphor comes from James, as does the phrase "marginal consciousness", though both terms occur in earlier writers.[12]

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published as *Esquisse de la phénoméenologie constitutive*). The *Field of Consciousness* was first written in English while Gurwitsch was at Harvard (this "Harvard manuscript" is still in Harvard's archives). His intention was to publish this text with Harvard University Press. However he did not agree with the referee reports he received, with the result that the book was first published in French translation in 1957, and then in English with a different publisher (Duquesne) in 1964. It was published in German after Gurwitsch's death in 1975. Though Gurwitsch only wrote the English edition himself, he was personally involved in the translations to French and German, and there are minor differences between them, given the "very different semantic horizons in the three languages" (Grathoff, 1989, p. 134). A new English edition was published in 2010.

[10] James' and Husserl's theory of time consciousness is taken directly from prior 19th century thinkers (Anderson & Grush, 2009).

[11] Husserl's personal copy of this book "shows intensive markings" in these chapters (Spiegelberg, 1971, p. 114).

[12] According to Google's data, the English phrase "field of consciousness" occurs in 5 sources before 1894. At least one author attributes the phrase to Wundt. "Marginal consciousness" in its current sense occurs first in a paper, "Focal and marginal consciousness" by C.L. Herick (1896).

1.3 Gurwitsch's Methodology

Gurwitsch was the first person to develop detailed interpretations of psycho-pathological cases using Husserlian tools, and was the first to integrate Gestalt psychology with Husserl's phenomenology. Though other 19th century figures also merged phenomenology, experimental psychology, and physiology in different ways (e.g. Fechner, Helmholtz, Wundt, Hering, Mach, and Stumpf) Gurwitsch was the first to apply this kind of mixed method to *Husserlian* phenomenology (Yoshimi, 2015).

Despite his naturalistic innovations, Gurwitsch's basic method remained classically Husserlian. Following Husserl, Gurwitsch gave methodological priority to reflection. He did not allow that empirical results could overturn phenomenological results. We depart from Gurwitsch in this regard. A growing body of evidence has shown that reflection and introspection are subject to numerous biases and distorting influences (Schwitzgebel, 2008). In light of these limitations, we follow what has emerged as a standard approach in consciousness studies: to base claims about consciousness on convergence between multiple types of evidence: introspective, behavioral, neural, etc. (Gallagher, et al., 2002; S. Gallagher & Schmicking, 2010; Jack & Roepstorff, 2002; Mangan, 1993; Petitot, 1999). This kind of pluralist approach has been described as a process of mutual revision and refinement, where phenomenological description, experimental data, consideration of neural correlates, and other sources of evidence constrain and support one other, "co-evolving" over time so that they can be "brought into reflective equilibrium, into a state where theory and data fit coherently together" (Flanagan 1997, pp. 101–102). As we will see, in several cases Gurwitsch's commitment to reflection as the primary source of evidence leads him in to conflict with empirical data, and in these cases we believe Gurwitsch's views can be revised and improved using a pluralist, co-evolutionary approach.[13]

2. Overview of Gurwitsch's Theory of the Field of Consciousness

Drawing on the many sources described above—from Husserl to the Gestalt psychologists—Gurwitsch developed a systematic theory of consciousness, encompassing its internal structure and dynamics. In this section we describe Gurwitsch's tripartite field structure (2.1), his account of field dynamics (2.2), and his concept of relevance (2.3). The theory is captured well by the field metaphor, which Gurwitsch explicitly elaborates using the example of an "electrostatic field" (Gurwitsch, 1979, pp. 62–63), a structured totality whose configuration changes over time in accordance with dynamical laws, and in response to changing circumstances. He gives the example of exposing an electromagnetic field to a piece of metal:

[13] Though our approach is pluralist, we also believe Gurwitsch's more traditional emphasis on phenomenological description has value. Those who study consciousness often give phenomenology a *lower* weight than other sources of evidence. Gurwitsch reverses this tendency, developing a theory that draws on empirical sources, but whose primary emphasis is phenomenological. The result is an unusually detailed picture of the conscious field, and inattention in particular (which is notoriously difficult to study behaviorally).

"the entire field will be disturbed and another field of a new structure...will be established" (Gurwitsch, 1979, p. 63).[14]

2.1. Theme, Thematic Field, and Margin

According to Gurwitsch, any field of consciousness is structured into the following three "domains" (see Fig. 1)

(1) Theme: data at the focus of attention organized according to Gestalt law
(2) Thematic field: unattended data relevant to the theme
(3) Marginal consciousness: unattended data not relevant to the theme

Gurwitsch says that this 3-part structure is, in some sense, necessary. He calls the three part structure "formally invariant...independent of any specification of content...exhibited by any field consciousness, whatever its contents" (Gurwitsch, 1964, p. 10).[15] So, according to Gurwitsch any field of consciousness can be parsed into these three co-present domains of data: theme, thematic field, and margin. The threefold distinction is based on two principles. First, a distinction between what is at the focus of attention (the theme) and what is in the periphery of inattention (the thematic field and margin). Second, a distinction within the periphery between what is relevant to the theme (the thematic field) and what is not relevant to the theme (the margin). For example, one might be reading a book (theme), having associated thoughts about the book (thematic field), and a variety of other marginal experiences irrelevant to the focal book reading; a sense of one's body, the room they are sitting in, and vague thoughts about dinner plans. Gurwitsch also claims that three types of data are always present somewhere in the field of consciousness: a sense of our inner thoughts (our "psychic self"), a sense of our bodies (our "somatic self"), and a sense of some part of the physical world.[16]

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[14] This calls to mind Köhler's theory that perceptual Gestalts are isomorphic to electro-magnetic fields in the brain. Lashley and Sperry are taken to have defeated this theory by inserting metal structures in the cortex of monkeys and cats and showing that their performance on perceptual tasks was unaltered (see Yoshimi, 2004 for review and citations). Gurwitsch does not endorse this electro-magnetic field theory, only the general metaphor. Our work can be viewed as elaborating the metaphor, and describing a variant on mental-physical isomorphism that emphasizes neural activity rather than electro-magnetic field configurations.

[15] Gurwitsch, following Husserl, has something like what is today called "metaphysical necessity" in mind, truth in all possible worlds, not just the actual world or worlds with physical laws like ours ("nomological necessity"). Gurwitsch says the process of "free variation" used to identify formally invariant structures "must not be confined to such varieties as are actualized in factual sense experience." Moreover, the laws one identifies in this way "must not be mistaken" for natural laws, like "all bodies are heavy" (Husserl, 1983, sec. 6). The idea that Husserl's concept of a phenomenological law (and by extension, Gurwitsch's) involves a form of necessity stronger than nomological necessity is generally accepted, though there are subtleties that go beyond the scope of this paper (Beyer, 2013 sec. 4; Mulligan, 2013).

[16] Similar taxonomies are deployed in several areas of philosophy. For example, Kriegel's self-representational theory of consciousness involves two intersecting distinctions: one between focal and peripheral awareness; another between inner and outer awareness (Kriegel, 2009). Brook and Raymont (2014), reviewing work on the unity of consciousness, distinguish the following topics of study: "consciousness of individual objects, of multiples of objects, of acts of experiencing, and of oneself as the subject of such experiencing" (sec. 2.2).

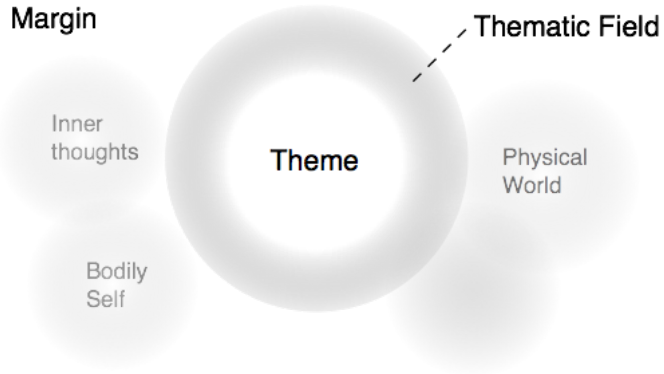

Fig. 1. Schematic of the field of consciousness showing its three main domains. Data in the theme and the thematic field are relevant to each other. Data in the margin can be relevant to each other, but are not, according to Gurwitsch relevant to the theme or thematic field. Gurwitsch believes three types of data are always present somewhere in the field: data concerning the physical world, inner thoughts, and the bodily.

Gurwitsch defines the theme as "that which engrosses the mind of the experiencing subject, or as it is often expressed, which stands in the 'focus of his attention'" (Gurwitsch, 1964, p. 4). Examples of a theme include an array of dots seen as a group, a face, a passage of music, or a mathematical theorem. Gurwitsch devotes over half of *The Field of Consciousness* to an analysis of the theme, developing an account that merges elements of Gestalt psychology, Husserlian phenomenology, and other sources.

Gurwitsch says that the internal constituents of the theme are so strongly interconnected that they cannot be detached from the theme without changing their phenomenal character: "when a constituent is removed from one contexture to be placed in another one... the constituent… may be so substantially altered and modified that, from the phenomenal and descriptive point of view, it is no longer what it formerly was" (Gurwitsch, 1964, p. 121). Gurwitsch gives the example of a melody: "A note has a certain musical significance in a given melody. The 'same' note may appear in another melody in which its musical significance is greatly different... For a subject not endowed with absolute pitch it is sometimes impossible to recognize the same note in the two melodies" (Gurwitsch, 1964, p. 117). Gurwitsch's phenomenology of the theme is notable for drawing so heavily on the experimental work available at the time. We will not consider Gurwitsch's phenomenology of the theme in detail here, though a comparison between Gurwitsch's account and contemporary perceptual psychology and psychophysics would be valuable.

Perhaps Gurwitsch's most notable contribution is his detailed analysis of *inattention* or background consciousness (we also refer to this as "peripheral consciousness"). Generalizing Rubin's (1921) analyses of the figure-ground organization of the visual field, Gurwitsch claims

that the theme "occupies the center" of the field of consciousness, while the rest of the field "forms a background with respect to the theme" (Gurwitsch, 1964, p. 319). Gurwitsch goes on to give a detailed analysis of peripheral consciousness. Suppose (to take a favorite example of Gurwitsch's) you are concentrating on a mathematical problem. The mathematical problem is your theme, but it does not exhaust the field of consciousness. As Gurwitsch says, "When we are dealing with a theoretical problem, more than the problem alone is given to consciousness" (Gurwitsch, 1964, p. 1). Gurwitsch goes on to elaborate various additional items that might be co-present in consciousness during the mathematical rumination:

> In a rather implicit, indistinct, dim, and penumbral manner, we may experience references to the possible solutions of the problem, or merely to directions in which a solution might be found, to assumptions and theorems which might seem to assist in solving the problem, to consequences which follow from a tentatively considered solution... While thus dealing with our problem, we furthermore have some vague awareness of both our actual environment and of ourselves. We perceive the room in which we are sitting, and the things which happen to be in the room. When we deal with our problem while walking in the street, we see the houses, the people who pass by, we hear noises, we may feel warm or cold. While walking down the street, we are aware of our walking and may anticipate that our walk will continue for some time, or else that we will soon reach our goal. Absorbed though our attention may be with our problem, we never lose sight of our actual surroundings nor of ourselves as situated in those surroundings. (Gurwitsch, 1964, p. 1)

So, according to Gurwitsch, non-thematic, peripheral consciousness has a fairly rich structure, encompassing a whole range of experiential constituents, including a sense of our body, part of the physical world, and other aspects of the mathematical problem.

Gurwitsch sorts the data of peripheral consciousness into two classes: data relevant to the theme, and data not relevant to the theme. Data relevant to the theme comprise the *thematic field*, while data not relevant to the theme comprise the *margin*. Data in the thematic field "tinge" or influence the way the theme is experienced, while data irrelevant to the theme do not. In the example above, references to the possible solutions of the problem are relevant to the person's thematic mathematical cognitions, since they seem to affect the way the theme is experienced. They are therefore part of the thematic field. In contrast, the person's perception of the street and its temperature, and sense of his or her body, are *not* relevant to the theme, and are thus part of the margin. The concept of "relevance" is left mostly intuitive for now (It is further elaborated in section 2.3 and critically examined in section 3.2).

Gurwitsch develops his account of the thematic field in part 5 of *The Field of Consciousness*. According to Gurwitsch, "the thematic field may be defined as a domain of relevance. It comprises all data co-present with the theme experienced as materially belonging and related to the theme" (Gurwitsch, 1964, p. 341). Gurwitsch allows for varying degrees of

determinateness and definiteness of a thematic field, but emphasizes that data in the thematic field are always "tinged" in a specific way:

> However diffuse, vague, obscure, and devoid of inner differentiation and discrimination the thematic field, it is nevertheless tinged in a specific manner. The facts to which we experience references when we read a scientific treatise, may blend into one another and present themselves as a coalescent mass. Still they are referred to as having something to do with those facts with which we are dealing at the moment…(Gurwitsch, 1964, p. 337)

Gurwitsch develops his account of the margin in the conclusion of *The Field of Consciousness*, and in a separate, unpublished manuscript, *Marginal Consciousness* (1985). Gurwitsch claims that data in the margin are irrelevant to the theme. The only relation marginal data bear to the theme is that of simultaneous occurrence. These are "data which, though co-present with, have *no relevancy* to, the theme" (Gurwitsch, 1964, p. 4), e.g. my sense of my body, background music, the ceiling fan, etc., as I engage in a series of mathematical thoughts.

Gurwitsch claims that three classes of data are always present somewhere in the field, at least as marginal contents: (1) some sense of our own stream of inner thoughts (the "stream of consciousness")[17], (2) some sense of our body, and (3) some sense of the perceptual world:

> At every moment...the stream of consciousness...our embodied existence, and the perceptual world present themselves to consciousness... the three privileged orders of existence together constituting reality are permanently present to consciousness. (Gurwitsch, 1964, p. 418)

He elaborates these three categories in *Marginal Consciousness*: (1) Self-awareness is our awareness of our own inner thoughts, a stream of ideas, concepts and inner speech constantly running through our minds. Gurwitsch states, "self-awareness permanently and necessarily pervades all of our conscious life" (1985, p. 6). Gurwitsch refers to the self we are aware of in this sense as our "psychic self." (2) In addition to the sense of our psychic selves, we also have an ongoing sense of our bodies, what Gurwitsch calls the corporeal or "somatic" self: "There is no moment in conscious life when we are completely unaware of our bodily posture, of the fact that we are walking, standing, sitting, lying down, etc." (1985, p. 31). Finally, insofar as we are aware of our body, we are aware of it as positioned at some location in the physical world: "Our body appears in experience under the perspective of the perceptual world and derives its positional index... from this horizon" (Gurwitsch, 1985, p. 56). Thus we always have at least some marginal consciousness of where we are in the perceptual world: "The perceptual world has...the privilege of omnipresence" (Gurwitsch, 1985, p. 40).

[17] In this context the stream of consciousness is not the total stream of experience unfolding over time, but (roughly) that "sub-stream" corresponding to inner thoughts. There is more detail to Gurwitsch's account of marginal self-awareness than what we are presenting here; cf. note 37.

2.2 Field Transitions

According to Gurwitsch, when we pass from the theme to an item in the thematic field—along a "line of relevancy"—this transition is felt to be *smooth*: "In passing to such items, the transition is smooth and continuous; we have the feeling that our thought moves in a right direction. Our thought moves along lines traced out by the very fringes escorting and surrounding the theme" (Gurwitsch, 1964, pp. 309–310). He also describes this as an absence of felt "breaks": "No break occurs in our mental activity insofar as we abide by the given thematic domain. Therefore, the present phase of our mental activity not only succeeds upon, but is also intrinsically connected with, the preceding phase" (Gurwitsch, 1964, p. 345). Since these are sequences of theme-thematic field transitions, we call these "thematic variations."

On the other hand, a transition from the margin to the theme is felt to be more abrupt and jarring. As Gurwitsch says in the context of his example of thinking through a theorem: "a break does occur...when, while dealing with the scientific theorem, some event happening in our environment forces itself upon our attention and makes us yield to its pull" (Gurwitsch, 1964, p. 345). Call these "marginal intrusions". An example of a marginal intrusion is shown in Fig. 2. In this example the theme is initially a conversation about a mathematical problem, with music in the background and a flowerpot nearby. During the conversation suppose you notice a bug on the flowerpot, and it suddenly becomes the focus of attention. The mathematical thoughts then become marginal, and may eventually fade out of the field altogether. While we stay focused on the flowerpot, we have variations on a new theme.

In addition to thematic variations and marginal intrusions, there may be other types of field transition as well (Arvidson, 2006).

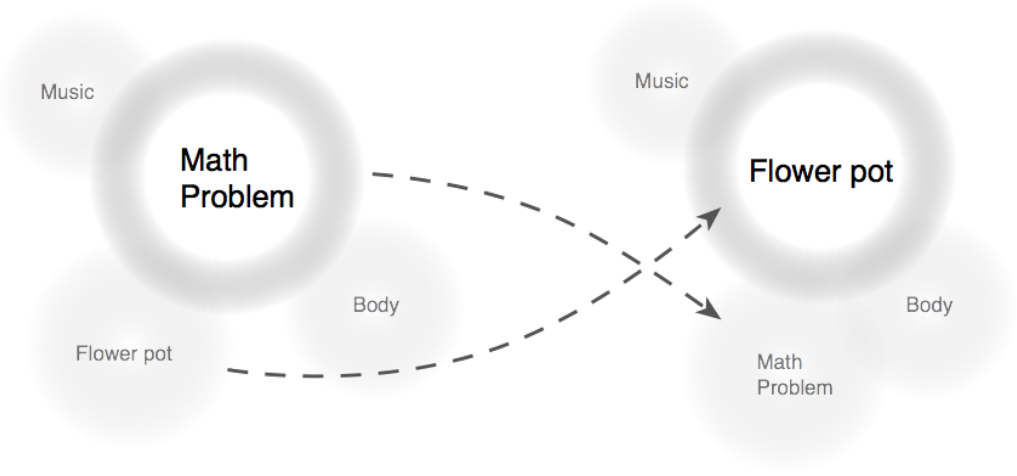

Fig. 2. Example of a marginal intrusion. An item in the margin becomes thematic. In this case, while discussing a mathematical problem a flower pot draws our attention.

2.3 Relevance

Relevance is a central concept for Gurwitsch: it is the basis of the thematic field / margin distinction (2.1) as well as the distinction between thematic variations and marginal intrusions (2.2). Gurwitsch develops several accounts of relevance. His official definition of "relevance" is that two co-present items in the field of consciousness are relevant if they are felt to be "intrinsically related" due to their "material contents" (Gurwitsch, 1964, pp. 342, 309, 340–341).[18] Roughly speaking, contents are materially related if they pertain to the same domain of knowledge: thus spatio-temporally proximal physical objects are materially related to one another, as are the concepts and theorems of geometry. However there is no material relationship between these domains: physical objects are not materially related to abstract geometric concepts. Thus, if I am attending to the Pythagorean theorem, my thoughts about the properties of right triangles are relevant to the theme because there is an intrinsic material relationship between right triangles and the Pythagorean theorem: they have to do with same domain of knowledge. But there is no material relationship, or so Gurwitsch suggests, between the Pythagorean theorem and my bodily posture. As Gurwitsch says:

> In contradistinction to marginal data where the only relation to the theme is simultaneous occurrence in consciousness, items belonging to the thematic field not only present themselves along with the theme, but as shown in our previous analysis, are also experienced as intrinsically related to the theme due to the material contents involved. (Gurwitsch, 1964, p. 358)

Gurwitsch also says that items in the thematic field "appear as *being of a certain concern* to the theme. They *have something to do* with it; they are *relevant* to it" (Gurwitsch, 1964, p. 340). Drawing on James' concept of a fringe of consciousness, he says that when one thing is felt to be relevant to another we feel a "sense of affinity" between the theme and those things that the fringes "points to": "The consciousness of pointing is one and the same as the experience of fringes attaching themselves to the theme" (Gurwitsch, 1964, p. 318).[19]

Gurwitsch also describes a kind of variational test for relevance, where one begins with a non-focal datum and varies it in imagination. If doing so changes the way the theme is experienced, it is part of the thematic field; if not, it is part of the margin:

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[18] Gurwitsch, following Husserl, distinguishes "material contents" from "formal contents" (Gurwitsch, 1964, p. 147). The formal / material distinction is hard to draw rigorously, but the intuitive contrast is between formal or logical contents, which do not depend on particular domains of knowledge (e.g. negation can apply to any statement and is thus a formal content), and material contents which do depend on particular domains of knowledge.

[19] James (1884) also describes the fringe using an extension of his stream metaphor: "Every definite image in the mind is steeped and dyed in the free water that flows round it. With it goes the sense of its relations, near and remote, the dying echo of whence it came to us, the dawning sense of whither it is to lead."(p. 16)

> [W]hereas variations of the thematic field … entail modifications of the perspective under which the theme appears, no effect results from changes occurring in marginal consciousness. (Gurwitsch, 1964, p. 415)

He develops this idea in the context of his example of thinking about a scientific theorem.

> To our scientific theorem it is of no concern whether, while dealing with it, we are sitting in a room or walking down the street. Perceptions of that part of the external world which is our actual environment, some awareness of both our embodied existence and of the stream of consciousness in its phenomenal temporality always accompany every activity of consciousness, whatever the theme of that activity. However, whether *these perceptions* rather than *different ones* are actually experienced, at the moment of our dealing with the theme, is of no importance and of no consequence to the theme.... Data of [this class] are characterized by their *irrelevancy* to both the theme and the thematic field with which they are co-present. (Gurwitsch, 1964, pp. 343–344)

Because of the connecting fringes and felt affinity between the theme and the thematic field, changing an item in the thematic field affects the phenomenal character of the theme (or the perspective under which it appears); changing an item in the margin does not affect the theme. For example, Christopher Columbus can be thought of in the context of his discovery of the Americas; he can also be thought of in the context of the (by many accounts, ravaging) behavior of his crew towards indigenous populations. The two different contexts make a difference to the perspective under which the theme, Columbus, is experienced. On the other hand, whether one thinks about Columbus while standing up or sitting down does not seem to have any bearing on the way Columbus is experienced. Thus, one's experience of sitting or standing is, in this case, part of marginal consciousness, while dim thoughts about Columbus' discovery of America or impact on indigenous populations are part of the thematic field.[20]

3. Extending Gurwitsch's Field Theory

In this section we show how Gurwitsch's field theory can be revised and extended in light of the current literature, and used to unify existing ideas, propose new hypotheses, and motivate a phenomenologically enriched account of the neural correlates of consciousness. In (3.1) we consider experimental data that suggests peripheral consciousness is less well articulated than Gurwitsch thought, though we defend the idea that the field extends beyond

[20] Gurwitsch's account of the thematic field is related to Husserl's account of (broadly speaking) "modes of presentation" of objects. Phenomenological theories of modes of presentation intersect with current debates concerning non-conceptual content, the phenomenal character of beliefs and concepts, and representational theories of consciousness (Gunther, 2003; Lycan, 2014; Macpherson, 2006; Tye, 2011). We largely bracket these intersections here (mainly by bracketing discussion of "contents" in the sense of represented states of affairs; cf. note 2), but there has been some discussion in the literature, focused on Husserl (Hopp, 2010; Shim, 2011).

focal attention. In (3.2) we consider what the neural correlates of a structured Gurwitschean periphery might be. Since it is here that we begin to consider neural correlates, we also review the literature on neural correlates of consciousness. In (3.3), we critically examine Gurwitsch's concept of relevance. We distinguish several types of relevance and show how one of these concepts—"causal relevance"—can be empirically tested. Current evidence suggests data in consciousness are almost always causally relevant to each other. This view is supported by what is known about the densely connected, "small world" structure of the networks that support consciousness. In (3.4) we extend Gurwitsch's theory of field transitions. We introduce another type of relevance, "predictive relevance", which can be used to more effectively distinguish smooth vs. jarring field transitions, and which can be linked with the operation of predictive networks in the brain. In (3.5) we extend Gurwitsch's account of the theme, developing the idea that the theme has a "variable size", expanding and contracting and sometimes disappearing altogether. In (3.6) we argue that Gurwitsch is right to emphasize peripheral awareness of our bodies, selves, and environment, though he goes too far in describing these as necessary field contents.

3.1. The Scope of Inattention

Gurwitsch defines the field of consciousness as a totality of data experienced at a time. He claims that we always have some awareness of our inner thoughts, our body, and some part of the physical world. In contemporary terms, Gurwitsch assumes a *rich view* of consciousness, as opposed to a *thin* or *sparse* view.[21] Schwitzgebel (2007) characterizes the distinction as follows:

> According to rich views of consciousness (e.g., James, Searle), we have a constant, complex flow of experience (or 'phenomenology') in multiple modalities simultaneously. According to thin views (e.g., Dennett, Mack and Rock), conscious experience is limited to one or a few topics, regions, objects, or modalities at a time (p. 5).

Gurwitsch joins James and Searle in endorsing a rich view of consciousness. In fact, it may be the *richest* view among current contenders, given how much he claims a person is conscious of at a time.

Thin views of consciousness have only recently become prominent, due to a series of experiments carried out in the last two decades on change blindness (some changes in an alternating sequence of visual scenes are not noticed) and inattentional blindness (some items in the visual periphery go unnoticed). Mack & Rock, (1998) showed that participants fail to notice a small "critical stimulus" while their focal attention is engaged in another task (i.e. saying which

[21] The debate is sometimes framed in terms of the question whether attention is necessary for consciousness (De Brigard & Prinz, 2010). From this standpoint, a thin view says that attention is necessary for consciousness (if you have consciousness, you have attention), and a rich view denies this. The two ways of framing the issue are not, however, identical. Someone could, for example, allow for a rich field of consciousness, and also endorse the necessity hypothesis, by considering "inattention" to be a region of diffuse attention.

line of a cross was longer) despite its being very close to where their eyes were fixated (see Fig. 3). More ecologically realistic tests were carried out in subsequent work. Simons & Chabris (1999) famously showed that a person in a gorilla costume could sometimes walk unnoticed through the middle of the visual field while participants' focal attention was engaged in counting the number of passes made in a game of basketball. The effect persists even with radiologists who "have spent years honing their ability to detect small abnormalities in specific types of images" (Drew, Võ, & Wolfe, 2013, p. 1848).

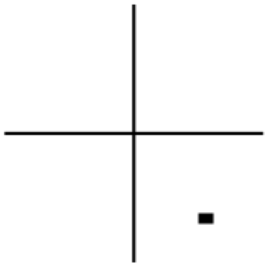

Fig. 3. When asked to determine which line is longer (and while gaze is fixated on the cross), some participants fail to notice the dot on the lower right. Image adapted from Mack & Rock, (1998).

These studies suggest that people have less experience of the visual periphery than their folk intuitions assume. Reviewing some of this literature, Schwitzgebel (2008) concludes:

> Through more careful and thoughtful introspection, [participants] seem to discover … that visual experience does not consist of a broad, stable field flush with precise detail, hazy only at the borders. They discover that, instead, the center of clarity is tiny, shifting rapidly around a rather indistinct background. My interlocutors – most of them – confess to error in having originally thought otherwise. (p. 256)

According to a strong form of the thin view, we are only visually aware of a tiny region of the visual field about the "size of your thumbnail held at arm's length" (Schwitzgebel, 2008, p. 254).

However, the experiments have not resulted in a decisive victory for the thin view. There are good reasons to think we have some awareness outside of this narrow tunnel. The experimental evidence for awareness in the visual periphery has a long history, extending back to the 1840's, when the study of visual field acuity began (see Strasburger, Rentschler, & Jüttner, 2011 for review). For a quick demonstration that you have *some* awareness outside the focus of visual attention, cup your hands around the edge of your face: it seems clear that something changes phenomenally when you do this. In fact visual field loss (in the most severe cases, tunnel vision) and related field defects are serious clinical problems (Johnson CA & Keltner JL,

1983). So even if we are unaware of some of what goes on outside the fovea, it is highly implausible that we have no peripheral awareness.[22]

It is a matter of ongoing debate what exactly inattentional blindness and change blindness show. Wolfe (1999) for example, suggests that subjects are aware of the gorilla while it is present, but fail to report it because they fail to encode it for later recall (what has been called "inattentional amnesia"). Or, it may be that subjects are aware of *something* in the periphery, but do not conceptualize it as a gorilla (what has been called "inattentional agnosia"). As Tse says, "we should not confuse the capacity to identify an attended object with experience of that object", and argues that when a person sees the gorilla movie without seeing the gorilla they "nonetheless experienced the blackness and motion" (Tse, 2013, p. 228, 233). Block (2008) argues that in iconic memory experiments (where participants are shown to have awareness of more items in a display than they can report) "much of the detail... is phenomenally registered [but] it is not conceptualized at a level that allows cognitive access" (p. 296).

These issues are difficult to resolve experimentally, because verbal report relies on attention. This in turn makes it difficult to study non-attentive, non-thematic consciousness using verbal report. Block (2008) calls this the "methodological puzzle":

> ...how can we find out whether there can be conscious experience without the cognitive accessibility required for reporting conscious experience, since any evidence would have to derive from reports that themselves derive from that cognitive access? (p. 292)[23]

Efforts to address this puzzle are ongoing. [24]

In giving methodological priority to reflection, Gurwitsch seems to have over-estimated the richness of the field, much like Schwitzgebel's interlocutors. As we saw, even for objects right at the center of the visual field (e.g., the critical stimulus, the gorilla, etc.) subjects sometimes fail to report seeing anything. On the other hand, there are good reasons to assume we have some peripheral experience. We can think of a revised Gurwitschean field theory as occupying a moderate or "middle class" position between rich and thin views of consciousness.

3.2 Structured Inattention and the Neural Correlates of Consciousness

The current debate about inattention has largely focused on whether inattention is a viable category. Assuming, as we do, that it is, there are further, largely unexplored questions about what its internal structure is. Gurwitsch attributes a specific structure to inattentional awareness,

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[22] For similar considerations see Koch (2004, Chapter 9.3).

[23] Compare James (1884) "As a snowflake crystal caught in the warm hand is no longer a crystal but a drop, so, instead of catching the feeling of relation moving to its term, we find we have caught some substantive thing…The attempt at introspective analysis in these cases is in fact like seizing a spinning top to catch its motion, or trying to turn up the gas quickly enough to see how the darkness looks...." (p. 3)

[24] For helpful overview see Simons (2000, p. 153), and Mole (2013 sec. 3.1). Further considerations for thin views are in (De Brigard & Prinz, 2010). Further considerations for rich views are in (Block, 2014).

which is consistent with what is known about the neural correlates of consciousness. Though it is unclear whether the details of Gurwitsch's view are correct, we believe he provides a plausible starting point for further investigation.

According to Gurwitsch, the field of consciousness extends beyond the focus of attention to encompass multiple non-focal contents. In addition to one's focal sense of what they are reading, for example, they might also have a vague sense of some part of their body, and separately from that, some sense of background music or an ache in their legs. Moreover, Gurwitsch suggests that these peripheral contents have a kind of center-periphery structure of their own. The music a person hears in the background is dimly experienced as one part of a larger passage of music. Bodily experiences, even peripheral ones, are "given in the shape of an obscure and confused horizon. *Every particular bodily experience appears*, so to speak, *with an index of appurtenance* to the realm of corporeity" (p. 35). Compare Fig. 1, where each peripheral content is pictured as a spherical region, with its own gradient, suggesting that peripheral contents like music and body aches are themselves felt to have a kind of context structure.

On this view, (1) we can have a distinct sense of multiple peripheral contents, and (2) each of these contents has its own center-periphery structure. Call this pair of hypotheses Gurwitsch's "structured inattention" view. This account is compatible with our moderate approach to inattention: even if inattention has a narrower scope than Gurwitsch thought, it is still plausible that what persists in the obscure periphery is structured in to separate contents which are surrounded by their own even more obscure horizons. The structured inattention view coheres well with the literature on neural correlates of consciousness, and is also phenomenologically plausible. Even when attention is focused a task—like writing this paper—music in the background and a lingering stomach pain feel different from one another. Moreover, insofar as they exist in peripheral experience, they seem to maintain some of the center-periphery structure they have when focal. A warm drink on a cold day can be felt in the stomach radiating to adjoining parts of the body. If you turn your attention from that warm sensation to a phone call, the feeling does not seem to become atomized.

Before turning to the neural evidence for the structured inattention view, we begin with a brief discussion of the neural correlates of consciousness (NCC). There is an emerging consensus that focal experience (the kind of experience available for verbal report) is subserved by activity in a distributed cortical-thalamic system, what is sometimes called the "global neuronal workspace" (Baars, Franklin, & Ramsoy, 2013; Dehaene, Kerszberg, & Changeux, 1998) or GNW. Studies extending back to the 1980's—for example, studies which contrast brain activity when a stimulus is consciously perceived with brain activity when the same stimulus is not perceived (e.g. masked or briefly presented)—suggest that consciousness is supported by a particular type of synchronous, coherent activity in cortex, a "global workspace". Stimuli produce activations in this space in a two-stage process:

> In a first phase, lasting from ~100 to ~300 ms, the stimulus climbs up the cortical hierarchy of processors in a primarily bottom–up and non-conscious manner. In a second phase, if the stimulus is selected… it is amplified in a top–down manner and becomes

> maintained by sustained activity of a fraction of GNW neurons. (Dehaene, Changeux, Naccache, Sackur, & Sergent, 2011, p. 58)

This global pattern of activation is associated with "an increase in high-frequency oscillations and long-distance phase synchrony."

In addition to the GNW activity supporting focal awareness, there are additional forms of diminished neural activity that could support Gurwitsch's two forms of peripheral experience. (The idea that peripheral experience is based on diminished neural activity goes back at least to James, who associated fringe experience with "faint brain processes").

One intermediate type of cortical activation—a kind of buffered sensory pattern—could be the basis of what Gurwitsch calls "marginal consciousness" (though we critique this concept of pure margin in the next section, we also argue that some version of the concept can be maintained). These patterns are intermediate between Dehaene's two "phases". They "involve resonant loops within medium range connections which maintain the representation of the stimulus temporarily active in a sensory buffer for a few hundred millisecond" (p. 4), and are thus beyond phase 1, but are not amplified by the endogenous fronto-parietal networks associated with attention and executive function (they are not phase 2). Tse describes the experiential correlates of these buffered patterns in a way that supports Gurwitsch's theory of marginal consciousness. In the absence of frontal amplification these networks produce low-level experiences or qualia of, for example, shapes and colors, and also more complex patterns, like colored surfaces (as evidence Tse notes that patients with frontal damage "appear to have experience, even if impoverished by the lack of executive and attentional function"; 1913, p. 232). These qualia are not, however, "bound" into the kinds of coherent, network-wide patterns associated with focal awareness and the operation of frontal networks. Given that constant buffered activations of this kind are produced by exogenous inputs from the sensory periphery (including kinesthetic and proprioceptive inputs from the body), Tse's account implies that we constantly have at least some marginal awareness of our physical environment and bodies.

Tse also sheds some light on the phenomenological character of these experiences. He speculates that in cases of frontal damage, e.g. in Balint's syndrome, experience may become a kind of "qualia soup", a pattern of local experiential features that have not been bound together by the endogenous operations of attention. This may provide a good analogy for the structure of the periphery in everyday phenomenology, a fragmentary qualitative structure which could allow for some sense of a patchy black surface, even when that experience has not been bound into a focal awareness of a gorilla. Even if fragmentary at any moment, this type of activation is available for rapid entry into focal awareness. Dehaene and colleagues (echoing Freud) call this "pre-conscious" activation. Tse describes these buffered patterns as "operands" that are available to be bound together by the operation of endogenous attention. Gurwitsch thinks of peripheral contents in the same way, as "potential themes" that may be transitioned to in subsequent experience (more in Sec. 3.3).

In addition to these neural correlates of marginal consciousness, a neural correlate of the thematic field has also been proposed (though not yet tested). Koch describes "penumbral" activations emanating from the activity supporting focal awareness (Koch, 2004, p. 241).

> The NCC at any one time will only directly involve a fraction of all pyramidal cells, but this firing will influence many neurons that are not part of the NCC. These we call the 'penumbra'. The penumbra consists of both synaptic effects and also firing rates…The penumbra includes past associations of NCC neurons, the expected consequences of the NCC, movements (or at least possible plans for movement) associated with NCC neurons, and so on (Koch, 2004, p. 46)

Revonsuo (2009) links penumbral activations with "what others [e.g. James and Mangan] have called the 'fringe' of consciousness… or 'peripheral awareness'"(p. 210).[25] These activations may produce the pattern of felt relations between the theme and associated contents Gurwitsch describes. The idea that reverberating activation patterns from a neural core produce diffuse feelings of relation or fringes also supports the second part of the structured inattention view, that each peripheral content has its own center-periphery structure. Buffered activation patterns could produce their own emanating activation patterns, which could produce center-periphery structures within inattention.

So the structured inattention view has some initial plausibility on phenomenological and neural grounds. However, it remains untested, and in fact there are several viable alternative hypotheses. For example, on an "*un*-structured inattention" view, the periphery would exist, but in an extremely undifferentiated, wisp-like form, without any separate contents. Such a view allows an inattentional periphery but denies both claims 1 and 2 of the structured inattention view. On such an account there is no distinction between peripheral music and a body ache, only a vague sense of "more" than what is in attention. There are yet other possibilities, e.g. a view whereby we have a separate sense of distinct inattentional contents, but those contents do *not* themselves have a center-periphery structure (thesis 1 but not 2 of the structured inattention view). Again, Gurwitsch's contribution here is to delineate a plausible starting hypothesis. Though inattention is difficult to study experimentally, there have been some advances (Block, 2014), and the relevant neuroscience is still in its early stages, so we are hopeful that evidence will begin to converge on one of these hypotheses.

3.3 Cognitive Holism and Small-World Networks

For Gurwitsch, the margin encompasses inattentional data that are not relevant to the theme. A conversation about the slope of a distant hill is, on Gurwitsch's account, irrelevant to one's peripheral sense of their body, and therefore occupies marginal consciousness. We argue that there are several different senses of "relevance", and that the evidence suggests that insofar as one form of relevance ("causal relevance") is testable, conscious data are almost always

[25] Koch himself is unclear about whether he takes the penumbra, in his sense, to be conscious.

relevant to each other. The data in the field are thus in a certain sense holistically interconnected, so that a completely irrelevant "margin" is at best an exceptional case. On the other hand, there may be *degrees of* relevance, so that a continuum exists between peripheral items more relevant to the theme (a kind of thematic field), and items less relevant to the theme (a kind of marginal consciousness).

Recall from (2.3) that Gurwitsch defines relevance in several ways. His official definition is that relevance is an intrinsic material relation between data. We will not make much use of this definition, because it is unclear how to determine when two data bear an "intrinsic material relation" to each other. One could argue that any two things are materially relevant to each other in some context. Someone might say that the Pythagorean theorem bears no intrinsic material relation to a mountain stream, but in some contexts (e.g. engineering a dam) these seem to be related. So, it is hard to see how to make use of this definition.

Gurwitsch also develops a more phenomenological definition of relevance, in terms of a feeling of "relatedness" or a "tingeing". Here the idea is that we simply feel one thing to be related to another. Relevance in this sense runs up against well-known problems with the resolving power of introspection (cf. Sec. 1.3). Who is to say whether the feeling of my body "tinges" my mathematical thoughts or not? Gurwitsch also offers a variational test of relevance: data are relevant to each other if variations of one datum affect the other. This corresponds to what we will call "causal relevance".[26] Gurwitsch's version of the variational test is not, however, very useful. We are asked to take a peripheral part of a field of consciousness, modify it in imagination, and then consider whether the focal theme would be changed by this modification. This is obviously a complex reflective process, subject to all kinds of distortions and introspective failures.

An experimentally tractable form of causal relevance—which captures the spirit of the variational test—can be defined. Consider participants in two conditions (see Fig. 4): either two groups of participants or one group of participants considered at two different times. Participants in the two conditions are placed in different circumstances, in such a way that some of their peripheral contents (P_1 and P_2) can be assumed to differ while their thematic contents (T_1 and T_2) are more or less the same initially. For example, suppose participants in condition 1 wear a backpack (P_1), while participants in condition 2 do not wear a backpack (P_2). Participants in the two conditions are then asked to perform the same thematic task of estimating the angle of a ramp. There are then two possibilities regarding the participant's subsequent thematic experience:

> 1) $T_1 \neq T_2$. Their thematic contents differ. This suggests that the different peripheral data influenced the theme. Therefore, the peripheral data are causally relevant to the theme.

[26] A reviewer raises the following question: Is causal relevance a brute causal relation, or is it mediated by unconscious inferential relations? For example, it could be that when a heavy backpack influences an estimation of the angle of a ramp, that this is due to an unconscious inference where the subject imagines climbing the slope with the backpack on, and concludes that it would be difficult. The question may be empirically tractable: as the referee notes, one could test for semantic priming of concepts involved in such an inference.

2) $T_1 = T_2$. Their thematic contents remain the same. This suggests that the different peripheral data did not influence the theme. Therefore, the peripheral data are not causally relevant to the theme.

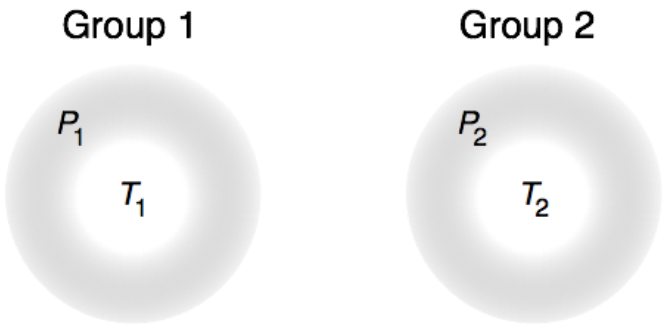

Fig. 4. Schematic of an empirical test for causal relevance. Experiments are set up so that P_1 can be assumed to be different from P_2, though T_1 is initially the same as T_2. In many cases these differences in peripheral contents are associated with subsequent differences in thematic contents. We take this as evidence that peripheral and thematic contents are causally relevant to each other.

Results from empirical studies in the field of embodied cognition suggest that inattentional data are often causally relevant to thematic data (for review of the embodied cognition literature, see Clark, 2008; Glenberg, Witt, & Metcalfe, 2013; Glenberg, 1997; Ziemke, 2003). Many variations in the body (and other seemingly marginal phenomena) have a detectable impact on focal attention. The studies considered are summarized in Table 1. While participants' peripheral experiences are manipulated to be different (e.g., members of one group hold a pencil between their teeth while members of another hold it between their lips), they engage in a common task assumed to be thematic (e.g., determine how funny a comic is). Individuals then report on some aspect of the current theme. If average responses differ significantly, peripheral data can be assumed to have impacted the current theme.[27]

Experiment	**Group 1 (P_1)**	**Group 2 (P_2)**	**Group 1 (T_1) vs. Group 2 (T_2)**

[27] Other studies which show that peripheral data can influence the current theme include (Glenberg et al., 2010; Higuchi, Hatano, Soma, & Imanaka, 2009; Linkenauger, Ramenzoni, & Proffitt, 2010; Linkenauger, Witt, & Proffitt, 2011; Proffitt, 2006; Taylor, Witt, & Sugovic, 2011; Witt, Linkenauger, Bakdash, & Proffitt, 2008; Witt & Proffitt, 2005).

(Bhalla & Proffitt, 1999) [28]	No backpack	Weighted backpack	Verbal judgments of ramp slope are steeper for participants carrying a weighted backpack.
(Proffitt, Stefanucci, Banton, & Epstein, 2003)	No backpack	Weighted backpack	Estimates of distance are greater for those wearing a weighted backpack.
(Durgin et al., 2009)	Weighted backpack	Weighted backpack + Cover story	Estimates of ramp slope are steeper when participants are not told a cover story about the weight of the backpack they are carrying.
(Strack, Martin, & Stepper, 1988)	Held a pencil lengthwise between their teeth (causing a smile)	Held a pencil from its end between their lips (causing a pucker)	Funniness ratings are higher on newspaper cartoon comics for participants who held the pencil between their teeth.
(Zajonc & Markus, 1982)	Nodding head up and down	Moving head side to side	Participants who nodded their heads up and down reported liking the headphones more than participants who moved their heads side to side.
(Williams & Bargh, 2008)	Held warm coffee cup	Held cold coffee cup	Estimates of a person's friendliness are greater when participants held warm coffee cups than when they held cold coffee cups.

Table. 1. Summary of experimental results.

These results suggest a kind of cognitive holism, according to which data represented in the field of consciousness typically exert a detectable influence on each other. Others have described a similar type of holism[29], and have linked it to the connectivity of the cortical network

[28] There has been some debate about the proper interpretation of this class of studies. In a follow-up experiment to Proffitt, Stefanucci, Banton, & Epstein, (2003), Durgin et al. (2009) showed that "when persuaded that the backpack served another purpose, participants' slope estimates were no different from those not wearing a backpack" (p. 1). For more recent theoretical discussions, see Firestone (2013) and Proffitt (2013). These discussions suggest that task demands can influence participant responses in embodied cognition experiments. This in turn suggests that field data are not *necessarily* causally relevant to each other (even if they often are), which is the view we endorse.

[29] For example Baars (1998), citing numerous prior researchers, refers to this as the "any to any" feature of cognitive processes involving consciousness. He supports this view with neural and behavioral evidence, including evidence

that supports consciousness (Baars, Franklin, & Ramsoy, 2013). This cortical network has a "small world" structure (Sporns, 2011; Sporns & Zwi, 2004): the number of synaptic steps it takes to move from one neuron to any other in the network is relatively small. [30] The different parts of the network are "effective connected" (Sporns, 2007, 2011) to each other, in the sense of tending to causally influence each other (hence the contents of the workspace are "available for global broadcast"). This provides a good explanation of why all the contents of a field of consciousness are causally relevant to each other: insofar as different field contents are supported by different regions of activity in the global neuronal workspace, and these regions are effectively connected to each other, causal relevance of field contents is exactly what we would expect.

Further work in this area could explore the *degree* to which different regions of neural activity influence each another, which could in turn be associated with degrees of causal relevance. Even if all phenomenal data typically affect one another, that does not mean they will do so with equal strength or efficacy. Measures exist—e.g. variants on mutual information like transfer entropy, or Granger Causality (Barnett et al., 2009)—which could be used to assess degrees of causal influence between activations in different cortical areas. Assuming some way of determining degree of causal relevance could be developed using these tools, a version of the thematic field / margin distinction could be recovered.

3.4 Field Transitions and Predictive Relevance

As we saw in (2.3), Gurwitsch distinguishes two kinds of field transitions: thematic variations along lines of relevance, which are felt to be smooth and continuous, and marginal intrusions across lines of relevance, which are jarring and abrupt. We have also seen (in 2.3 and 3.3) that multiple types of relevance can be distinguished: e.g. forms of material relevance like spatio-temporal proximity, and causal relevance, which is empirically testable. This raises the question of whether, as Gurwitsch suggests, relevance (in *any* of the senses we have considered) could be used as the basis of an account of the phenomenology of field transitions.

Causal relevance won't work as it stands, insofar as, on our account, it holistically connects all field elements and thus cannot be used to distinguish different types of field transition (though insofar as there are degrees of causal relevance it could work, as we will see). It also seems clear that "material relevance" is not associated with experiences of smooth vs.

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that "one can apparently gain novel voluntary control, at least temporarily, of *any* neural system with the help of biofeedback training" (p. 100).

[30] Compare the "Kevin Bacon" phenomenon (Collins & Chow, 1998), according to which the human social network is a small world network, so that most people in the world are related to the actor Kevin Bacon by just six intermediate personal acquaintances. Sporns & Zwi (2004) describe this phenomenon as it applies to the case of the macaque cortex: "the graph [i.e., the macaque cortical network] is strongly connected since all nodes can be reached from all other nodes in a finite number of steps (between 1 and 4). In functional terms, this means that all regions of the macaque cortex can communicate with all other areas. The shorter the path length, the 'easier' it is to pass information between all pairs of nodes" (p. 25). The same small-world structures has been observed in human cortex (Sporns & Zwi, 2004, p. 111).

jarring transitions, at least not in any obvious way. Consider a variant on the flowerpot example discussed in (2.3). One of us recently spoke to a friend who intermittently attended to a flowerpot, pulling dead stems. Thematic contents moved fairly regularly between experiences of the flowerpot, a physical thing, and experiences of the more abstract topic of conversation. These were *not* experienced as jarring marginal intrusions, even though they crossed lines of material irrelevance (from the spatio-temporal realm of physical objects to the abstract realm of discussion). Conversely, one can have all manner of jarring or abrupt experiences even while remaining in the domain of spatio-temporally proximal things: if a bird flies through a wedding ceremony, for example, or if we notice a gorilla in a basketball game.

A more plausible account of the distinction between smooth and jarring experiential processes is in terms of expectation and surprise. When things go as we expect, experience unfolds smoothly and transparently. When something unexpected occurs, we experience an abrupt transition. If a friend says something uncharacteristic, a passage of music takes an unusual turn, or a glass of what you thought was soda turns out to be milk, you are surprised.

What Gurwitsch should have done, on our account, is use the concept of expectation to develop yet another concept of relevance, what we will call "predictive relevance". The predictive relevance between a theme and a peripheral item is (roughly) the probability of transitioning to that peripheral item, given what the current theme is (this may simply correspond to degree of causal relevance—cf. the end of 3.3—though for now we treat the two concepts separately). The more the theme predicts that a given peripheral item will occur next the more predictively relevant that item is to the theme. Peripheral items which are highly predictively relevant to the theme are experienced as a kind of *sense of what's coming next*, i.e., what Husserl and Gurwitsch called "adumbrations" or "protentions". When adumbrations materialize as expected, experience unfolds in a smooth way. When they fail to materialize as expected, a disruption is experienced.

These ideas are consistent with a vast body of empirical evidence. Andy Clark, summarizing decades of research in neuroscience and machine learning, describes brains as "prediction machines... bundles of cells that support perception and action by constantly attempting to match incoming sensory inputs with top-down expectations or predictions" (Clark, 2013, p. 1). On this account, the brain—and in particular the cortical thalamic system that supports consciousness—is a kind of statistical machine, a collection of networks, each of which develops a model of its normal inputs and activity, which it then uses to predict subsequent inputs. Prediction errors (the discrepancy between what is expected and what occurs) produced by these networks are used to update and refine the statistical models, so that over time error is reduced. Expectation is also a central explanatory construct in a wide variety of experimental domains, including perception, cognition, and language, among others.[31] When we watch a

[31] Expectations have been shown to occur in vision (Bar, 2004; Hubbard 2005, 2014; Vinson, Abney, Dale, & Matlock, 2014;), touch (Turvey, 1996), speech perception (Skipper, 2014), motor behavior (Jordan, 2009; Wolpert & Flanagan, 2001), joint action (Knoblich & Jordan, 2003), event perception (Zacks, Speer, Swallow, Braver, & Reynolds, 2007), memory (Abney, McBride, Conte, & Vinson, 2014; Brandimonte, Einstein, McDaniel, & others,

moving object, we implicitly track its course and predict where it will go. When we drive through a neighborhood we have more or less specific expectations about what exists around each corner. Similarly when we listen to music, engage in conversation, and so on through a remarkably broad range of cases. The brain develops, maintains, and continually updates internal models of the world—of the neighborhood, the piece of music, the way things move, our friends' personalities and what they will say about something, etc. These model-based expectations are so dominant, that what we hear, for example, may be more about what we expect than about actual sensory inputs: "what we 'hear' may come more from the brain than our ears… the function of [the auditory cortex] is to confirm or deny internal predictions" (Skipper, 2014, p. 1). Those items that are most strongly predicted by these models may be pre-attentively or "penumbrally" activated. For example, to those familiar with the song, hearing "the star spangled…", will call "banner" to mind, in virtue of such pre-attentively activated representation.

These predictive networks can be used to explain the phenomenology of field transitions. When prediction error is low, and brain activity unfolds in accordance with internal statistical models, smooth sequences of thematic variations unfold. One after another, the regions of neural activity supporting peripheral adumbrations (something like the penumbral activity Koch describes) are amplified to become neural activity supporting new themes. When neural activity unfolds in this way, the field of consciousness moves along lines of predictive relevance. On the other hand, when prediction errors occur in the brain, expectations are violated, and field transitions that are in varying degrees jarring occur. Structural features of the relevant neural networks are updated to reflect the unexpected information. Over time we develop increasingly accurate models of our environment, and experience tends to be smooth.[32]

Here again there is additional integrative work to be done. Relevance theory in pragmatics seeks to understand how listeners and speakers understand one another, based not only on the semantic values of terms, but also context information (Sperber & Wilson, 1996). If a friend returns from a fruit stand wiping his mouth and tell his friend, "I liked it", the friend will assume he is talking about fruit, and not a book or a kiss. Using a database of over 100,000 online business reviews (from the website *Yelp*), it has been shown that, roughly speaking, the use of specific types of words in a review is influenced by contextual factors such as the emotional valence of the review (Vinson & Dale, 2014). This suggests that affective state plays a role in determining what one writes in a review, which in turn suggests that what appears as predictively relevant in the thematic field as a person writes a review is influenced by these factors. Predictive relevance also coheres with the idea that fringe experiences reflect the brain's ongoing retrieval of unconscious context information (Mangan, 2003). Mangan conceptualizes the processes in terms of degrees of fit between focal contents and information in unconscious context. He describes a specific class of experiences—feelings of rightness or knowing—which

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2014), musical cognition and emotion (Krumhansl, 2002), statistical learning (Dale, Duran, & Morehead, 2012), and language (Levy, 2008).

[32] These ideas are developed in more detail in Grush (2006), who analyzes Husserlian / Jamesean time consciousness in terms of trajectory estimation models, which are versions of the predictive neural mechanisms described above.

guide how consciousness unfolds. This may be a refinement of our idea that when expectations are met smooth thematic variations occur (that is, what we call "smooth" transitions are associated with degrees of phenomenological "rightness").

Field transitions could be visualized using mathematical models of the neural correlates of consciousness. It is has become common to think of a network's activity—in this case, the thalamo-cortical network supporting consciousness—in terms of a trajectory unfolding in a high dimensional state space, representing all possible patterns of activity for that network (Yoshimi, 2011). "Attractors" in the state space of these networks—that is, regions corresponding to stable activation patterns that a network will tend to settle in to—have been associated with focal experience (Mozer, 2009). As the brain's state changes over time, a trajectory moves from attractor to attractor, pulled from one stable region to another as external stimuli and other conditions change. These kinds of dynamics have been increasingly prominent in the recent literature, with theorists describing "open dynamics" (Hotton & Yoshimi, 2011), "transient dynamics" (Rabinovich & Varona, 2011), "meta-stable dynamics" (Kelso, 2012), and "chaotic itinerancy" (Tsuda, 2015).[33] These meta-stable dynamics could be conceptualized using graphs (in the graph-theoretic sense, i.e. network diagrams), where each vertex or node corresponds to an attractor, and each edge or link between vertices correspond to a likely transitions between attractors. Such a graph could be used to visualize the neurophenomenology of thematic transitions. At any time the currently active vertex would correspond to the current stable brain state and the focal theme it produces. Vertices connected to the current vertex (which could also be dimly highlighted) correspond to brain states that are likely to occur next, and are associated with predictively relevant contents in the thematic field of the current theme. When activation passes from one vertex to a highlighted neighboring vertex in such a graph, smooth thematic variations occur. When surprises occur, expectations are updated, and the graph would have to be updated as well. Such a graph could actually be produced in a simulation of a cortical network in a virtual environment (for a simple, idealized example, see Yoshimi, 2014).

3.5 The Dynamics of the Theme

Gurwitsch holds that there is always a theme or focus of attention in a field of consciousness; this is one of his "formally invariant" structures. However, it is not clear whether it's true that a theme must occur in every field of consciousness. When just waking up or falling asleep, or in the aftermath of a punch to the face, is it the case that a person experiences some focal, unitary whole before them? Or consider James' concept of transitive phases of consciousness. According to James, when we move from perceiving one stable object to another, we have vague, intermediate, "transitive" experiences that are hard to characterize. James compares these to the "flights" in the "flights and perchings [of a bird's life]" (1884, p.3). James

[33] An impressive array of behavioral techniques have also reinforced these ideas by showing how underlying continuous dynamics can be detected even in apparently discrete tasks (Spivey, 2007), e.g. in the patterns followed by the eyes or a computer mouse in a recognition task.

also refers to the "confused, dazed, scatterbrained state which in French is called *distraction*, and *Zerstreutheit* in German" (1890, p. 261). He gives the example of those few moments before answering a question or doing something: "somehow we cannot start; the *pensée de derrière la tête* fails to pierce the shell of lethargy that wraps our state about" (1890, p.261). These are complex and understudied cases that challenge the claim that every field of consciousness has a theme.

Gurwitsch also claims that the theme necessarily has a specific structure: the structure of a Gestalt unity, that is, "a unitary whole of varying degrees of richness of detail, which, by virtue of its intrinsic articulation and structure, possesses coherence and consolidation and, thus, detaches itself as an organized and closed unit from the surrounding field" (Gurwitsch, 1964, p. 114). A paradigm example would be looking at a cup in good lighting without distraction. The cup is at the center of attention and it appears as an organized unit that detaches itself from the rest of the visual field. However, it is not clear whether the contents of consciousness are *always* coherent Gestalt unities that cleanly segregate themselves from their visual surroundings. Again consider falling asleep, a transitive phase of consciousness, or a punch to the face. Or take the case of a foggy mist, a dark corner of a nightclub, or swimming underwater with your eyes open. It is not clear in any of these cases whether a unitary whole detaches itself from its surround. Or again: consider the Ganzfeld effect, where participants experience "an all-encompassing gray fog" after being exposed to a completely uniform field of color (Palmer, 1999, p. 18). This can happen outside laboratory settings, such as in an arctic tundra where both ground and sky are the same color. Something similar occurs when one simply shuts their eyes. It is not at all clear that determinate Gestalt unities detach themselves from their surround in these cases.

A final problem for Gurwitsch's theory of the theme is that he identifies it both with the focus of attention and with the figure part of a figure-ground structure, in the Gestalt theoretical sense due to Rubin (1921). Palmer, reviewing the literature on the issue, warns explicitly against such a conflation, primarily because it is possible to attend to the ground in Rubin's sense (Palmer, 1999, p. 283). In fact, there is evidence that visual attention can be allocated to non-contiguous regions of the visual field, resulting in "split attentional foci" (Kramer & Hahn 1995; Awh & Pashler 2000).

Taken together, these observations suggest a more dynamic and variable account of the theme than Gurwitsch proposed. The focus of attention can be conceptualized as having a variable size, sometimes covering more, sometimes less content, based on "a limited supply of processing capacity, or resources, that can be allocated in varying amounts to different tasks" (Eriksen & James, 1986, p. 225). The relationship between this variable size focus and Gestalt structure is also complex. When attention is "zoomed out" or "distributed" (Palmer, 1999; De Brigard & Prinz, 2010)—for example, when one is day dreaming, distracted, or maintaining readiness for peripheral events—there is no obvious center of the conscious field, and there is less likely to be any Gestalt unity structuring the center of the field. When attention is "zoomed in", it will typically be organized around one or several objects, as Gurwitsch thought. However, even in the case of a sharp focus there is no requirement that the theme be organized according to

Gestalt principles (there is an extensive literature studying the degree to which attentional selection is based on spatial locations vs. spatially invariant object representations; for review see Cave & Bichot 1999; Palmer, 1999, ch. 11). As we saw, the focused part of the visual field can correspond to the ground of a figure-ground structure, or even to a collection of non-contiguous regions. Referring back to Fig. 1, we can think of the theme as varying in size and "shape" over time, sometimes diffusing over the whole field to such an extent that there is arguably no theme at all, and other times organizing itself either around an object in accordance with Gestalt laws, or around a more exotic type of content. The transitive periods of the stream of consciousness—the flights in the "flights and perches" James describes—may correspond to periods when the cortico-thalamic systems is transitioning between stable brain states, i.e. the brief periods when it is traveling between nodes in an attractor graph, when the connecting lines are "activated" (cf. 3.4).[34]

Further integrative work could begin by clarifying how the concept of Gestalt structure generalizes beyond the visual case. Gestalt phenomena have been studied in audition and other sensory modalities (Bregman, 1990; Todorovic, 2008; Gallace & Spence, 2011): similar clicks and tones are naturally grouped (similarity), and ascending series of clicks interrupted by a short pause are still experienced as a single ascending series (good continuation). An improved theory would further specify how how object-perception is related to attention (the two are clearly linked, but the connection is complex). The advancing neural evidence in these areas could facilitate further neuro-phenomenological integration. Object perception in accordance with Gestalt laws is associated with activation in the lateral-occipital cortex (Grill-Spector & Malach, 2004). This object-based activation does, however, substantially change when one focuses on a hole, i.e. something like the ground of a figure-ground structure (Vinberg & Grill-Spector, 2008). Attention is associated with fronto-parietally mediated amplification of activity in the thalamo-cortical system supporting consciousness (Dehaene, Changeux, Naccache, Sackur, & Sergent, 2006; Tse, 2013). Changes in the "size" of the attended region correlate with the extent of the enhanced region (though as the enhanced region extends, the level of activation in each subregion decreases; Müller, Bartelt, Donner, Villringer, & Brandt, 2003). Finally, there may be other forms of dynamical field configuration beyond those described here, e.g. those associated with intense emotions, flow experiences, certain drug-induced states, and meditative states.

3.6 Peripheral Awareness of Mind, Body, and World

According to Gurwitsch, we always have some awareness of (1) our own inner thoughts or psychic ego, (2) our body or embodied existence, and (3) some aspect of the perceptual world.

[34] Precursors of this idea can be found in the early connectionist literature, where the stream of consciousness was described as a sequence of stable states, in which, for example, "[ideas] come, seem promising, and then are rejected; leads in the solution to a problem are taken up, then abandoned and replaced with new ideas'". These theorists also speculated that intermediate periods between stable states—when the relevant networks are settling in to new attractors—correspond to "unclear phenomenal impressions" (Rumelheart, Smolensky, McClelland, & Hinton, 1986, p. 39).

This implies that any field of consciousness contains contents of each of these three kinds. As Gurwitsch says: these "three privileged orders of existence together constituting reality are permanently present to consciousness" (Gurwitsch, 1964, p. 418).

This has some surface plausibility: we do often seem to have some inner thoughts, some sense of our bodies, and some sense of where we are in the world. We already saw that buffered activation patterns based on exogenous sensory inputs could support our marginal awareness of body and self. The small-world circuits that support consciousness are tightly linked to muscles and viscera of the body, and to the brain's physical environment, via "high bandwidth couplings" (Gibson, 1986; Hotton & Yoshimi, 2011).[35] These couplings, together with the system's dense inter-connectivity, suggest that there is typically at least some buffered sensory activation in the global neuronal workspace, generating experiences of body and world. Studies of default mode activity in the brain further suggest that activations corresponding to "episodic memory, planning for the future, inner speech or simulation of behavior" (Fransson, 2006, p. 2844) are typically present. These sources of input may not be sufficient to produce the coherent activity that underlies thematic experience, but—if our suggestions about the neural correlates of inattention in (3.2) are correct—it may produce enough activity to support peripheral awareness of mind, body, and world, consistently with Gurwitsch's ideas.

While we agree that mind, body, and world are all typically present in the conscious field, it is not clear that they are *necessarily* present. Recall that for Gurwitsch a formally invariant structure of consciousness applies to *all possible* fields of consciousness (see footnote 15). But it seems possible in principle that someone could have a conscious experience in which they had (1) no inner thoughts at all, (2) no sense of their body, or (3) no sense of the physical world. In fact, there is some evidence that such cases occur. Flow experiences (e.g. playing basketball "in the zone") or "entrainment" are characterized by a loss of reflective self-consciousness (Nakamura & Csikszentmihalyi, 2002; Jennings, forthcoming). Loss of proprioception and body sense, more generally, are known clinical syndromes, vividly characterized by Sacks (1995). Further, various degrees of sensory deprivation are possible, including, in the most extreme case, locked-in or total locked-in syndrome, which seem to involve a global loss of awareness of one's physical surroundings (Bauer, Gerstenbrand, & Rumpl, 1979).[36]

There is further work to be done integrating all three of Gurwitsch's domains of peripheral experience—experiences of the world, the body, and self—with contemporary research. Our pervasive sense of the world bears an obvious relationship to the embodied cognition literature (cf. Sec. 3.3). Much of this literature describes the intimate ways bodily and environmental features can influence cognition. To take just one example, given their different bodies, a young person's concept of a chair is demonstrably different from an older person's, and

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[35] Further support comes from experimental psychology, in particular studies of concepts and conceptual reasoning (Barsalou & Wiemer-Hastings, 2005; Glenberg, 1997). For example, given their different bodies, a young person's concept of a chair is demonstrably different from an older person's, and similarly for people of different weights.

[36] Kriegel (2009) gives a contemporary defense of the view that peripheral inner awareness is a necessary feature of conscious experience.

similarly for people of different weights (Barsalou & Wiemer-Hastings, 2005; Glenberg, 1997). Given how deep these influences are, proponent of embodiment have questioned the very idea that the mind is distinct from the body and environment (Clark, 2008; Clark & Chalmers, 1998; Jordan, 2009; Noë, 2004). Our Gurwitschean approach maintains a kind of "internalist" emphasis on the brain as the proximal basis of consciousness, but allows that the structure and dynamics of that brain activity (and hence the corresponding conscious activity) is itself conditioned by environmental and bodily influences (Yoshimi 2012). There is also an emerging literature on bodily awareness which could further clarify its status in the overall field. De Vignemont (2011) has described a complex taxonomy of types of bodily awareness, which draws both on phenomenology (Gurwitsch and Merleau-Ponty in particular) and on the clinical psychology and neuroscience of body representations. Finally, the study of self-representation has also been active in recent decades, particularly in the philosophy of mind. Higher order theories of consciousness hold that "conscious states are conscious in virtue of being targeted by suitable higher-order representations", and "self-representational theories" hold that "conscious states are conscious in virtue of representing themselves in a suitable way" (Kriegel, 2009, p. 358; also see Rosenthals, 2004 and Brook & Raymont, 2004). The idea that some kind of experience of self is *constitutive* of consciousness resonates with Gurwitsch's theory, though if—as we have suggested—field configurations without such a self-representation are possible, then such theories could run in to trouble.[37]

4. Conclusion

The extended field theory is well suited for deeper integration with contemporary research in the cognitive sciences. On our account, a field of consciousness is a dynamically unfolding, holistically inter-connected pattern of phenomenal data. A stable theme of attention sometimes takes form within this field. When it does, it is contextualized by a structured periphery of inattention. Inner thoughts, bodily awareness, and a sense of the physical environment are usually present in the field. Field data are almost causally relevant to each other: change one part of the field of consciousness, and other parts will typically be affected as well. When adumbrations are amplified and expectations are fulfilled, the field unfolds smoothly and transparently; when expectations are violated, abrupt transitions occur. This theory of field structure and dynamics can be integrated with existing theories of the neural activity that supports consciousness. The ebb and flow of the theme is supported by meta-stable dynamics in the thalamo-cortical system, where neural activity settles into one stable pattern after another, with transient periods in between. Peripheral experience is supported by buffered activity in the

[37] Gurwitsch's own view of marginal self-consciousness is more complex than what we have presented here. Gurwitsch endorses something close to the self-representationalist idea that self-representations accompany all conscious perceptions (Gurwitsch 1985). However, Gurwitsch (following Sartre) denies that any kind of "transcendental ego" or "pure ego" (Gurwitsch 1979 ch. 11) exists in consciousness, i.e. a sense of self that, for Husserl, is at the center of any conscious experience. We have not taken a stand on these issues, and have only made the minimal assumption that one often has some kind of inner life—a running stream of inner thoughts and images.

global neuronal workspace that has not been enhanced by front-parietal networks, and by penumbral activations emanating from the activity supporting the theme. These processes unfold in a small-world network, constantly influenced by inputs from the body and the world. As predictions made by internal models encoded in the network are confirmed, the field unfolds smoothly. When those predictions are disconfirmed, more or less abrupt breaks occur, and internal models are updated.

We have also tried to give a sense of the many open questions and directions for future research suggested by Gurwitsch's theory. To name a few: Which hypothesis about the structure of the inattentional periphery (assuming it exists) is the correct one, and what are the neural correlates of that structure? How is the variable-sized theme related to Gestalt-structured object representations? How well do these relationships, whatever they are, generalize across sensory modalities and to non-sensory cases? How precisely should causal relevance be defined, and how is it related to predictive models in the brain and unconscious retrieval mechanisms? How do other factors known to influence linguistic behavior, e.g. one's knowledge of others or a person's affective state, affect the way predictive relevance is computed? How can different types of field transition be visualized, and related to meta-stable attractor dynamics in the brain? How precisely are self, body, and world experienced? Are there other field configurations beyond those we have discussed? The Gurwitschean perspective facilitates progress on these and related questions, by placing them in a single, coherent, framework, emphasizing the total field of consciousness and its internal dynamical structure.

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