Philosophical Issues, 18, Interdisciplinary Core Philosophy, 2008

THE COMMON NOW

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I. Introduction

The manifest image is teeming with activity. Objects are booming and buzzing by, changing their locations and properties, vivid perceptions are replaced, and we seem to be inexorably slipping into the future. Time—or at least our experience in time—seems a very turbulent sort of thing. By contrast, time in the scientific image seems very still. The fundamental laws of physics don't differentiate between past and future, nor do they pick out a present moment that flows. Except for a minus sign in the relativistic metric, there are few differences between the temporal and spatial coordinates in natural science. We seem to have, to echo another debate, an "explanatory gap" between time as we find it in experience and as we find it in science. Reconciling these two images of the world is the principal goal of philosophy of time.

Two very different conceptions of time allegedly correspond to the above two images. On the so-called tenseless view, all times are on a par, there is no flow, and the present moment is not distinguished. The fundamental temporal properties are the relations of precedence and simultaneity. The past, present and future do not, strictly speaking, exist; this division only makes sense relative to a given event. In particular, the present moment—the now—is not at all special, since the present for some event is comprised merely of those events simultaneous with it. This conception of time is found in the scientific image. In classical physics, for example, time is conceived as a one-dimensional topological space that is homeomorphic to the real number line. None of the real numbers are distinguished as special, nor are any greater or lesser except relative to a specified number. Tense theories, by contrast, take their cue from conscious thought and action, which divides times into

the trichotomy of past, present and future. Tensers reify these categories found in our egocentric view and claim that they are objective classifications. Unlike the relation 'to the left of,' which needs two objects to make sense, 'in the present' makes sense as a monadic non-relational property according to tensers. For tensers your reading this sentence is present *simpliciter*, not present merely relative to other cotemporaneous events. Tensed theories of time come in many forms, but most judge the present objectively special. It may be the only time that exists (presentism), the cusp of the moving now (becoming), or the point at which some future "branches" disappear. In all these theories the present is not something that can be read off from the set of all relations of precedence and simultaneity in the world. The common now is ontologically elite, something extra not captured by physical theory.[1]

An ontologically special present has been the target of nearly a century's worth of attacks. Conceptual arguments, like McTaggart's, and scientific arguments, like that from special relativity, try to demonstrate that this tensed present is logically and physically impossible, respectively. Focusing on impossibility proofs, however, has had unfortunate consequences for the detenser. First, detensers probably have not succeeded in obtaining outright victory. Second, excessive concentration on outright victory left the tenseless theory hollow and undeveloped when it came to explaining our experience and intuitions. This result was natural; after all, if the tensed theory could be shown impossible, detensers win. They could then explain the phenomena at their leisure, confident in victory that it must be possible. However, if this "nuclear" strategy fails and the debate becomes "conventional," that is, a debate over which theory *best explains* the phenomena, detensers are left with little to say. Beginning with our egocentric view of the world, tensed metaphysical systems are commonly said to be more in tune with our experience of time than tenseless theories.

Does experience really favor the tensed theory? Although that is the usual advertising, I believe it is an open question. Contemporary analytic philosophers of time typically point in a perfunctory way to various stock mental experiences as a justification of their byzantine metaphysical systems. One is told that we feel time pass or that the present is sensed as special—as if we know exactly what that means—and that we can only explain this through a tensed metaphysics. Meanwhile, those who have studied temporal experience in detail, e.g., phenomenologists and contemporary cognitive scientists, typically remain silent about the metaphysics.

It's time detensers stand up for themselves and challenge the claim that experience favors tenses. This paper has a negative and a positive aim. After briefly arguing that there is no "experience of the present" as contemporary metaphysicians conceive it, the paper turns to the main topic: explaining why people have the powerful intuition that there is a mind-independent Now and don't believe the same about the spatial Here. The positive part of the paper offers a new theory explaining this difference. Oddly, given the

central role temporal experience plays in philosophy of time, empirical work on time perception is virtually absent from this literature. When this neglect is rectified, one sees resources emerging in recent experiments in cognitive neuroscience and psychology that bear on the problem. If I am right, we already have enough information for us to fill out significantly the best explanation of the difference between the Here and Now.

II. The Problem of the Presence of Experience

The philosophy of time literature often speaks of "the problem of the presence of experience." However, a variety of problems actually go under this name, and as we'll see, few have anything really to do with experience, and none are damaging to the tenseless theory of time.

Consider some experience, say, reading this paper. While you read this—right *now*—you're experiencing the present. Reading the beginning of the previous sentence is now fading into the past and new events are being "lit up" by the feature of presentness. These new events—reading *this* sentence—are now present. Is there something in this prosaic experience that is problematic for the detenser?

I believe that there is only if one reads the theory into the data. One frustrating feature of the metaphysics of time literature is that it habitually does this. For example, Craig 2000 claims that we are "appeared to presently" (139), where he means via a tensed present, and Schlesinger 1991 claims that the present, unlike the past and future, is "palpably real" (427), as if we stand outside the realm of what exists and can feel the contrast with the unreal. To evaluate such claims, we must carefully disentangle the experience itself from judgments and descriptions of it. Since our mental representations of the world are often tensed, it's often natural to describe our experience as if we are interacting with some feature of the external world called presentness. Yet it's hardly clear that *being present* is a phenomenal property. Even if it were, it wouldn't follow immediately that there is an objective tensed present, for we know that there are plenty of experiences for which a similar inference would be mistaken, e.g., as in hallucinations.

Is *being present* a phenomenal property? Right now I sense my computer humming, black and white colors, and pain in my lower back, but I don't perceive a stamp of presentness on any experience. I am not at all sure I have an experience of presentness—as opposed to simply at present having an experience. Moreover, it seems that there are two pretty good reasons to deny this phenomenological property exists—arguments even tensers agree with (e.g., Hestevold 1990). The first is Mellor's 1998 point that objects look the same to us even if they are in the past. The experienced point of light from Jupiter is of an object an hour in the past. Other points of light in my visual field may look the same even if the source is roughly present or something a million years old. Since events look the same despite tremendous

differences in age, the view that we're sensing the property of *being present* of objects/events seems problematic.

The tenser Craig 200 protests:

> as a result of physics and neurology, we now realize that nothing we sense is instantaneously simultaneous with our experience of it as present. But in most cases, the things and events we observe are contained within a brief temporal interval which is present . . .and our basic belief makes no reference to instants, so that such a basic belief remains properly basic even for scientifically educated persons like ourselves. The fact that under extraordinary circumstances our basic belief in the presentness of some event/thing should turn out to be false is no proof at all either that we have no basic beliefs concerning the presentness of events/things in the external world or that such beliefs are not properly basic. Mellor is therefore simply wrong when he asserts that we do not observe (defeasibly) the tense of events. (143)

This response is untenable. We may well have *beliefs* concerning the presentness of events in the external world, but that doesn't mean we *observe* the tense of events. Moreover, contrary to Craig, there is nothing "extraordinary" about seeing stars or hearing thunder after seeing lightning.

The second reason to think *being present* is not a phenomenal property is that phenomenal properties distinguish some experiences (or aspects of experiences) from others (Hestevold 1990). The property *being loud* distinguishes some experiences from quieter experiences, and being red distinguishes parts of my visual field from other (say) blue parts. But every experience is present, and so the property doesn't play this crucial role.

Due to these objections, it is natural to reformulate the idea as: the objects we perceive aren't present, but the sensory experiences we have when we perceive them are. In other words, conscious experiences are confined to the present. The metaphor of a spotlight moving along a wall, where the light is supposed to be present conscious experience, is popular here. Despite its popularity, this claim clearly begs the question. On a tenseless conception all times are on a par. My experience of my first day at school is a conscious experience, but alas, it is in the distant past. To avoid begging the question, the claim must be that *in the present* all my conscious experiences are present. Yet this tautologous statement is something the detenser happily can endorse. To cause trouble for the detenser, the tenser must read the theory into the data again.

Given these snags, it shouldn't be too surprising that the quandary the literature usually dubs "the problem of the presence of experience" in fact has little-to-nothing to do with experience. Here, for example, is a recent statement of the most prominent problem:

> The challenge I wish to consider is that manifested by conscious experience. . . [T]he present is experientially privileged in that we are only ever capable of experiencing that which occurs in the present. To put this observation another way, though we may know all week that the movie and Friday, 1:00 p.m. are

> simultaneous, when we learn that Friday, 1:00 p.m. is present and, therefore, that the movie starts now we seem to learn a new fact. Accordingly, tenseless relations cannot be all there is to time and the best explanation of the presence of experience is that the present is ontologically privileged, more real than other times. (Mozersky 2006, 441–442)

Mozersky is summarizing the objection one commonly finds—for instance, in Ludlow 1999 and Craig 2000—to a tenseless metaphysics. Notice that the connection with experience is so deeply ingrained in the literature that even a detenser like Mozersky provides an experiential gloss in the first two sentences of quote—in contrast to the actual problem. The actual problem is precisely what Perry 2001 calls the Temporal Knowledge Argument. This argument is the temporal version of the Knowledge Argument in philosophy of mind, wherein colorblind Mary has an operation to recover color vision and thereby allegedly learns a new non-physical fact. Perry declares the temporal counterpart of this argument to be the "heart" of the tensed theory. He is right. The argument comes in many forms, but the core idea is that tensed propositions give knowledge or make certain behaviors rational that tenseless propositions do not.

Evaluation of such arguments hangs on delicate issues regarding indexicals and contexts of representation, not experience. Making the debate about this argument means that all the claims about the present being *experienced* as special and privileged are mostly rhetorical bluff unrelated to the actual argument for tenses.

Is this argument, whether experience-based or not, a good one? Not at all. Indeed, I believe the continued reliance on it in philosophy of time is something of a scandal. The Temporal Knowledge Argument and related puzzles (see Mozersky 2006) plainly reflect quite general features of indexicals. There is nothing special about temporal indexicals here. We've known for a long time that indexicals are essential: replacing non-indexicals into indexical beliefs doesn't preserve the cognitive significance and explanatory power of the original indexical beliefs. It is true that the correct semantics for terms like 'now' and 'present' is a complicated and open project. I have neither the space nor ability to delve into it. However, even without possessing the final, true theory of temporal indexicals, we know that the argument isn't compelling because there is nothing special with respect to temporal as opposed to spatial and personal indexicals. The argument works, mutatis mutandis, to show that the Here and the Self exist. I suppose one could bite this bullet. But even then the result would not be a theory of time different from our theory of space. (For a detailed rebuttal of the most recent versions of the argument from temporal indexicals, see Mozersky 2006).

The other argument in the literature advertised as stemming from experience of the present is again about an attitude about this experience, and this time the problem favors detensers. Here it is:

> Whoever I am, and whenever I believe my experience to be present, that now-belief is true. This is the inescapable presence of experience that we B-theorists must explain away (Mellor 1998, 44)

The detenser's solution, admitted as a good solution by some tensers, is simply to treat the present as an indexical. Since the present then picks out that very experience, my belief that the experience is now is bound to be true. The only question is whether various tensed theories can offer as compelling an answer.

The last hurrah of the tensed argument from the presence of experience comes in the form of complaints against the tenseless account of temporal indexicals. Application of the Kaplan-Perry treatment of indexicals results in (although it was independently devised by J.C.C. Smart and others) what is known as the token-reflexive account of the truth conditions of tensed statements. The token-reflexive account states that the truth conditions for the judgment that some experience *e* is present is that *e* is (roughly) simultaneous with the judgment. Many complain that there is some phenomenological fact ignored by the token reflexive analysis. The detenser Balashov 2005 argues that the token reflexive account misses the fact that some experiences are "more radically" present than it allows; Falk 2003 holds that "presentness is an inextricable part of all sensory awareness. . .and A-theorists are right to insist on an account of the experience of presentness that does not appeal to any reflexivity" (221). The critics are undoubtedly correct. The token reflexive account explains a *correlation* between a type of judgment, belief or other propositional attitude about presentness and an experience. It doesn't account for or describe an experience itself—that's not it's job.

The question then is, what is the experience tensers want to appeal to? We're back to square one. Detensers admit that the representations are tensed. Is there anything more than that? Balashov 2005, for example, tries hard to identify this experience not captured by the token-reflexive theory. He says tenseless accounts to date miss the crucial feeling, the feeling of events "simply occurring" (295). What is it to simply occur? Balashov struggles to say. At one point he explains that the "hard problem" of the presence of experience is that "some experiences are known to be *occurring*, or *present*, as opposed to *not* occurring, or *absent*" (296). But if this problem is about knowledge (and not feeling), and in particular, knowledge at one time that other experiences don't exist—as opposed to don't exist now—then the claim is clearly question-begging. Later Balashov settles on the "distinctive aspect" of occurrence as the alleged fact that "present experiences are known to be occurring *simpliciter*, in addition to occurring when they are" (298). This again pushes our question back: what is occurring *simpliciter*? The answer is more Latin—the experience, he says, is "*sui generis*" (298)—but we never get more *lumen*.

In sum, we have not found any distinctive aspect of experience that deserves to be dubbed experience of being present. Direct appeals to phenomenology are rare and unconvincing. Instead the literature focuses on various puzzles involving temporal indexicals and then adds a thin coating of phenomenological language to justify the use of the word "experience." And the trouble with temporal indexicals vanishes as soon as one runs the spatial and personal indexical versions of these arguments. We have not found good reason to posit a phenomenal property of *being present*.

III. The Common Now

Although temporal indexicals function like spatial indexicals, our language and thought about time is sometimes very different than it is in the corresponding cases about space. In particular, we seem endowed with some very powerful intuitions supporting the view that reality is divided into past, present and future, and that this is so not merely relative to one's current perspective. Focusing on the present, Butterfield 1984 identifies three such intuitions.

> We more readily take as real the presently-existing objects, wherever they are, than the objects that are at some time located here. . .We are more apt to give sentences time-variable truth-values than space-variable ones. . .And we think of ourselves as sharing a common, albeit ever-changing, *now,* while we each have a different *here*. . .. (161)

To elaborate, and starting with the first, consider the way we existentially quantify in natural language. We might use "there is" with absolutely widest scope, meaning that there is said entity at some time or other at some location or other, as when we say that a spacetime has a singularity in it, or we may restrict the scope to the present time, as when we say that there aren't any dodo birds. Call the first *eternalist* quantification and the second *presentist* quantification. Eternalist quantification doesn't distinguish time from space; presentist quantification clearly does. The claim is that we use presentist quantification far more naturally than we do its spatial counterpart, quantification restricted to a location.

Regarding the second, the claim is that we more readily accept truth-values changing with time than with space. I admit that I am dubious of this claim. I think we're equally happy with indexing, for instance, "It is raining" to changing locations as changing times.

The third is the most compelling intuition. We tend to think of ourselves as sharing a common mind-independent now but aren't tempted by such a claim about the here. By this I mean more than merely that we find ourselves believing in a unique foliation of the world into simultaneity classes. That is true. But we additionally believe that one of these simultaneity planes is distinguished. People think of the present as the only real or determinate

time, as something that moves, and so on. The strength of such an intuition is evinced by the existence of philosophy of time itself, with so many philosophers arguing for presentism, as well as the reaction one finds in students when teaching the relativity of simultaneity. Part of the shock of relativity is its conflict with the idea of a special common now. The relativity of co-location, by contrast, garners mild interest. We don't have any of these intuitions regarding the here. To my mind, this intuition of a privileged common now is the deepest one and also the one responsible for the other two, to the extent that they exist.

Spinoza thought that, insofar as we are rational, we ought to direct ourselves to the future, present and past equally. Apparently an early advocate of the tenseless view, he evidently believed that one ought to dismiss our intuitions that favor the now. While we may ultimately wish to do so, as I mentioned at the outset, dismissing the intuitions instead of explaining them leaves the tenseless account of time somewhat hollow. It is better to explain these intuitions where they are strong and then evaluate them after an explanation.

IV. Present Patches

Why do people invest such significance in a common now but not to a common here? If the tenseless theory is right, people are mistaking their egocentric representation of the time with objective time itself. Why do we conflate the two in the case of time but not space?

Part of the answer, I think, comes from the fact that for most of history, both in scientific and in lay thought, people subscribed to what the historian of physics Jammer 2006 calls the *visual simultaneity hypothesis*. This hypothesis holds that events that are seen together are simultaneous with one another. No comparable spatial version of this hypothesis seems to have been entertained; from an early age we learn that some objects we see are local (e.g., my feet) and some far away (e.g., that distant mountain). For most of history experts and non-experts agreed—explicitly or implicitly—that light traveled at an infinite or effectively infinite speed. Authorities such as Aristotle, Descartes and Kepler argued that this must be the case, and the ordinary person would have no experiences that suggested otherwise.[2] Only in 1676 did the Danish astronomer Olaf Roemer suggest observations that supported the finite speed of light (it better explained the otherwise mysterious eclipses of Io). Soon thereafter Bradley vindicated this claim.

If one thinks that everything one sees, no matter how near or far, happen at the same time, one can see how natural and tempting the idea of a unique global objective now becomes. Time is one-dimensional and directed (or at least the processes in it are directed). As a result, one cannot freely move to the past, nor are there orthogonal temporal directions to explore. Memories accumulate in this one direction. Furthermore, the true relativity

of simultaneity is more or less hidden on terrestrial scales to instruments as coarse as we. One is this stuck traversing one's timeline in one direction, and so is everyone else. Now if you additionally believe the visual simultaneity hypothesis, you therefore believe that everyone you see and interact with shares your now. Our being "stuck" ensures that you won't meet anyone or go anywhere to experience any conflicting evidence. No one will see anyone claiming yesterday is now, remembering your future, and so on. In these restricted circumstances, I claim, it is not at all surprising that one might confuse the egocentric now with an objective one. By contrast, thanks to our free mobility along three spatial dimensions and no spatial counterpart of the visual simultaneity hypothesis, we are not at all tempted to confuse our egocentric here with an objective here. We know the here is not special because we can move around to other ones and see other people's here's that are not common with ours.

Of course, the visual simultaneity hypothesis is false, and there are senses other than vision. So this line of thought needs more development. The *locus classicus* of tenseless explanations of the intuition of the common now is Butterfield 1984. In both outline and direction, I think it offers the best view to date of a detenser's account of the common now intuition. As his paper provides some of the theoretical framework of the present endeavor, it is worthwhile going through its essential argument.

Think about our typical environment from the perspective of physics. Most macroscopic objects typically change their macroscopic properties relatively infrequently. While electrons, quarks, etc. are buzzing around incredibly fast, constantly changing their non-essential properties, the macroscopic properties of objects such as their size, color, etc. are relatively stable. The world is macroscopically stable thanks to macroscopic objects being nearly electrically neutral, chemically stable, unlikely to spontaneously fluctuate to new macrostates, etc. Now consider our visual perception of such objects. Light is bouncing off these objects and reflecting into our eyes. These objects are typically terrestrial, so the travel time is virtually instantaneous. However, processing the light in the visual system of the brain takes time. The chemical transduction on the retina takes time, as does the neural transmission. The total is roughly 0.5sec. This is roughly the time lag it takes between the state of the object at time t and the formation of our belief (tacit or not) about it at time t^*.

The interesting thing about this time lag is that, given that objects change their macroscopic properties relatively slowly (typically), the time lag does not end up falsifying the relevant belief. Photons reflected from my orange chair are absorbed in my eye and processed in a complicated mechanism. The result of this process is a belief at t^* that the large object 1m away at t is chair-shaped and orange—and at t^* it (typically) still is chair-shaped and orange! The lag t^*-t typically doesn't make the belief about local macroscopic objects false.

Of course, this makes perfect sense from the perspective of evolution. Although one needs to be cautious in making such statements, evolution plausibly would select for creatures whose beliefs about the world match the world as best as possible for each time t. I am not suggesting that evolution selects true beliefs, but merely that large lag times usually would not be conducive to survival. Large lag times plus fast tigers wouldn't help reproduction. Ceteris paribus, there will be evolutionary pressure to make t*-t smaller than that needed to typically respond to environmental dangers.

Now consider communication, say, by signing. (We'll treat non-visual modalities in a moment.) If I sign "the chair is orange" to you, there will again be a lag. This time, the delay arises from the lag from my visual processing system, the lag arising from my signing, and then the lag of your visual processing. But this total lag is still very small, just over a second, and typically it won't be enough to falsify the information. Typically the chair's orangeness will survive the lag. We can take the statement to be true at the moment of utterance *and* the moment of reception. Naturally this feature will be crucially important when trying to coordinate action.

The same story can be repeated for sound and touch. Sound, of course, travels much slower than light (330 m/s in normal atmospheric conditions). However, the auditory system, relying on mechanical transduction, is much faster than the visual system. The tactile sense is the same way. As a result, we can reliably communicate in typical environments about macroscopic objects without including a *time stamp*, i.e., the B-temporal relations, of the event we're speaking about. We can say "the bird is in the tree" or "the bird is now in the tree" and manage to impart useful information. We don't need to say "the bird is in the tree at 12.58.03 GMT" to someone standing near enough to hear.

Not all of our means of communication permit the ability to go without time stamps. Consider a world in which we can only communicate by smell or by post. Burnt toast can linger in a house all day. The smell of toast does not reliably stamp when it was burnt. Similarly, a letter in the mail without a date on it can often be useless. In both cases the lag makes a difference. Smell as a consequence of its lag is usually unreliable; the post is reliable but only if the date is stamped on the letter. With no date provided, a letter from your bank can be worthless.

Fortunately, in our world, we don't need to rely on smell or date-less post. As a result, given the stability of macroscopic properties and the short t*-t lag for modes of information transfer, we can reliably gain and communicate information about the world *without the use of a time stamp*. We can say or sign "now" and in typical situations both the source and the receiver can communicate and interact without confusion.

It didn't have to be this way. Getting reliable information transfer without the need of a time stamp is highly contingent: on our brain's processing,

on the type of world we live in, on even the temperature (since the speed of sound varies considerably with temperature). One can imagine things going differently. Perhaps some worlds are "long" worlds where beings are adapted to perceive thunder and lightning as simultaneous, either for reasons of processing or facts about how often observable properties of macro-objects change. Imagine dark and very humid worlds wherein organisms can't communicate as reliably via sight or sound. Perhaps other worlds are "short" worlds wherein the window of simultaneity is much shorter. A world wherein observable properties of objects are typically changing much more quickly than here may be one wherein beings could only reliably communicate visually and not through sound (just as we typically communicate through sound but not through smell).

Butterfield's framework lends itself to the following picture (which he doesn't suggest although I suspect it's implicit). Call a 'present patch' the spatiotemporal region over which typical observers in typical environments do not require a time stamp in order to reliably navigate their environments. Agents assume others are like them. Just as they can form beliefs about 'now' and the beliefs typically are not falsified by the lag, so they assume for others. These assumptions are reinforced by the reliability of local communication. A 'global common now' is built by patching together these local nows (see Fig. 1). The inter-subjective agreement leads to the idea that this 'global now' is objective. And since observation creates beliefs about distant objects, we aren't as inclined to create a 'global here' as we are inclined to create a global now. Call this theory the Present Patches theory. This theory is a hypothesis seeking to explain various features we associate with the present. It is an entirely tenseless theory according to which the present is not an objective metaphysical global entity, but rather a local mind-dependent constructed one.

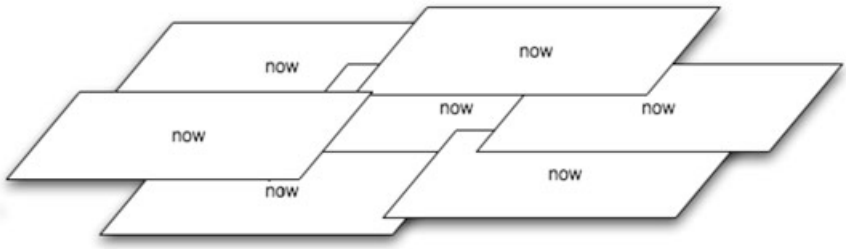

Fig. 1

Butterfield has it more or less right. His paper suggests a satisfying framework for explaining how and why we take the present to be objective and global. The small time lags involved in communication and in belief formation help explain why the present seems to be a mind-independent feature of the world even though it is not.

V. Putting the Mind into the Mind-Dependent Present

Although I admire the Present Patches theory, it is a bit short on details. Curiously, the mind-dependent theory of the present, from Grünbaum to now, has never really focused on the mind. The main character in the story has been left out. Not only does this leave the theory a bit bare, it omits the most crucial and fascinating part. The mind is doing a lot of work in constructing present patches. The picture emerging from recent work in cognitive neuroscience, behavioral psychology and psychophysics is one wherein the mind employs a set of temporal integration mechanisms. The outputs of these mechanisms are present patches, but these patches need not be co-extensive with the patches picked out via time stamping, as described earlier.

A temporal integration mechanism is, as the name suggests, a mechanism that integrates the stimuli bombarding our senses into temporal units. Our brains are constantly under siege from a confusing and chaotic barrage of information about the internal and external worlds. Sticking to the eternal world, information is coming at us from any given event via light, heat, sound, and more. Each of these signals reaches us at different times, thanks to different signal speeds. Even within a sensory modality this may be true, for (say) sound from an event typically will reach one ear before the other. The processing that occurs within the various sensory organs also takes different amounts of time. So does the neural processing, which depends on the pathway appropriate to the sensory modality. We may also be rigged so that particular features of the target sensed affect the speed of processing differently, e.g., the intensity. Add to all of this the effects due to environmental conditions, e.g., whether it's humid, and internal conditions, e.g., whether you're alert, and one quickly sees that, a priori, there is no guarantee at all that when the stimuli reach your consciousness that they will bear any correspondence to the true temporal relations among events. Yet if we're to successfully navigate about the world, we had better have representations that make pretty good temporal sense. That is, the world has objective temporal relations. Some events precede others and some occur simultaneously. To be successful, we need to tell whether that rattling sound comes from the same place and time as that snake image popping into view, and whether jumping left quickly will help one escape.

One of the most remarkable features of the brain is that, despite the onslaught of time-varying information from external events, we somehow manage to get things more or less right. The brain employs various mechanisms that integrate the information gained from various sensory sources. These mechanisms take advantage of different temporal windows and other mechanisms that actively recalibrate the size and shape of these windows. These mechanisms weld together sequences of events into a kind of gestalt. In particular, these mechanisms "decide" what events (and what

aspects of what events) to count as simultaneous and what events to count as non-simultaneous. The neuroscientist Pöppell (1988 and references therein) has long argued for the existence of various such mechanisms:

> . . .our brain furnishes an integrative mechanism that shapes sequences of events to unitary forms. . .that which is integrated is the unique content of consciousness which seems to us *present*. The integration, which itself objectively extends over time, is thus the basis of our experiencing a thing as present. (Pöppell 1987, 62–63)

Now there seems to be broad agreement that various mechanisms are needed, and there is more knowledge about what these mechanisms do. There is disagreement over the number of such mechanisms, what they do, how they relate to one another, what type of neural activation realizes them, and so on, but there is little disagreement that such mechanisms are needed.

What I want to do is add these temporal integration mechanisms into the Present Patches theory. Instead of having to define our local nows in terms of time stamps, we can instead define them more realistically in terms of the nows produced by the temporal integration mechanisms in the brain. These are also local and (of course) subjective, but they allow us at the very least to put some flesh on the bones of the account. It is because of the integration mechanism that we perceive certain events as simultaneous and not others; and it is the similarity between this mechanism in each person that allows us to agree on what events happen now. No doubt there are connections between this mechanism and the story mentioned about time lags and the environment. Had the environment been different this mechanism would surely have evolved differently or not at all. But with the temporal integration mechanism, we can now pinpoint more directly the source and extent of the local nows.

Adding the temporal integration mechanisms to the story is a step toward further realism. But it has philosophical consequences too. It explains why the rather behaviorist "time stamp" theory holds to the degree it does, for the mechanism offers the more fundamental process in the theory. We take the present to be global and objective thanks to the operation of this mechanism. Its explanatory power also lays down a kind of challenge to the tensed theory.

VI. What Makes a Present Patch

In this section I want to describe some of the fascinating ways by which the brain creates the experienced present moment. The experiments described will make the case for temporal integration and also detail some types of integration.

Let's begin with synchronization within a sensory modality. Consider first the classic experiments by Hirsh and Sherrick 1961 and expanded by Pöppell 1988 and others. Put headphones on a subject and let her listen to

tones lasting for 1ms. If the left and right ears are stimulated simultaneously, then the subject hears not two tones but one fused tone. One can then stimulate the two ears non-simultaneously but very close together at 2ms apart, and the two acoustical stimuli will still be fused together. But if one stimulates the two ears much further apart, say at 3ms or 4 ms, we pass the fusion threshold and suddenly hear two clicks. These experiments are one way of determining what events seem present to us and what events do not. Two audio events in this context separated objectively by (say) 2ms will appear as one event and not one followed by another. Our subjective present is wide enough to include both events as one. Of course this fact should not surprise anyone: if time is continuous and we are finite, we wouldn't expect to perceive arbitrarily short events any more than we should expect to see electrons. For obvious reasons, this interval during which events are fused is called the modality's "window of simultaneity," which is a concept that will be useful to us.[3]

Interestingly, the window of subjective simultaneity varies from person to person, from 2ms to 5ms. It also varies with age, older people fusing more events than younger people. In each person, the minimum threshold of simultaneity cannot be shrunk. This is the same for the other sensory modalities, too, such as visual and tactile senses. In each of these, there will be a minimum window of fusing events together as subjectively present (up to 10ms for tactile sense, 20ms for vision) but this will vary from person to person. We don't usually notice these differences, but they can become apparent when making very precise measurements—as in an infamous episode at the Greenwich observatory in 1796 (see Mollon and Perkins 1996).

Consider now the binding of multisensory signals from a common target into a subjectively simultaneous whole. This audio-visual simultaneity window also varies from person to person. Stone et al show that the point of subjective simultaneity is observer specific.[4] However—revealed in another experiment—the point of subjective simultaneity is remarkably stable for each individual.

Suppose a friend from across the room shouts "Now!" The light carrying the visual information is traveling at 300,000,000m/s and the sound is lagging behind, traveling at merely 330m/s. This difference in speed is compensated, in part, by two processes that favor sound: (a) the mechanical sound transduction by the hair cells of the inner ear is many times faster than the chemical phototransduction in the retina, and (b) the neural transmission time from the visual cortex to the cerebral cortex is greater than that from the auditory cortex to the cerebral cortex. The exact calculations will depend on various features,[5] but it turns out that the horizon of simultaneity between light and sound in perception intersects at about 10m from the subject. That is, (a) and (b) cancel out the difference in signal speed when you're 10m away from your friend.

Why, then, does the image of your friend's mouth match the sound even when he or she is closer or further away than 10m? How does the brain figure

out that the sound and light were emitted simultaneously when the processes described by (a) and (b) don't cancel the speed discrepancy? Of course, at some point the brain does not weld the two aspects of the event into a simultaneous whole. The phenomenon of thunder and lightening is perhaps the most conspicuous such case. We hear the sounds later than seeing the light. And if the event is up close, we can react more quickly to an auditory source than to a visual one; so up close there are cases where the brain—at least for quick reactions—is not waiting for the visual processing to catch up. Still, the brain is surprisingly tolerant of asynchronous information. There are no noticeable discrepancies between the image of the lips moving and the sound "Now!" at any typical communication distance. From experiment (Dixon and Spitz 1980) we know that your friend can emit "Now!" as much as 250ms after moving his or her lips before you would notice the discrepancy. Why is this?

One answer is simply that the multisensory temporal integration window—the multisensory counterpart of the simultaneity window discussed above—might be very wide. See Fig. 2. If the amount of time required to bind together cross modal stimuli is large, then we simply wouldn't notice

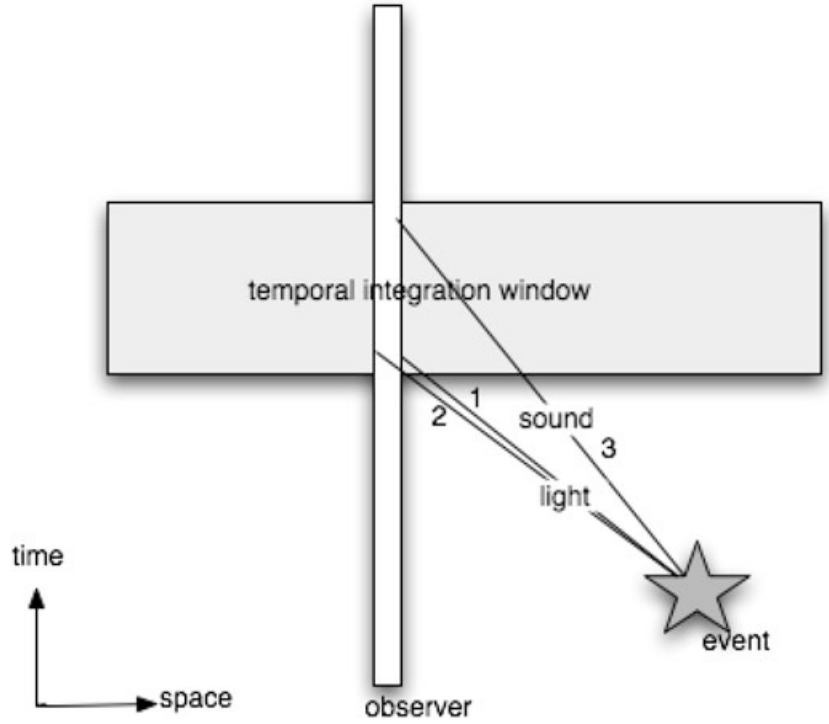

Fig. 2

small asynchronies between the light and sound. Since binding together information from across the sensory modalities must take *some* time, processes (a) and (b), coupled with a wide temporal integration window, will surely play an important role in any explanation of subjective simultaneity.

Is a wide integration window the full story? It seems not. While research is ongoing, the literature has revealed other possible mechanisms of enforcing perceptual synchrony. These mechanisms radically alter the size, shape and behavior of the integration window pictured above.

Temporal Ventriloquism

Ventriloquism is the ancient art of making a sound appear in a spatial location that is not its source. Famously the sight of the puppet's mouth captures the sound emanating from the puppeteer. Since the puppeteer's mouth is not visibly moving the brain matches the sound's location in space to the mouth that is visibly moving. The modality appropriateness hypothesis (Welch et al 1986) is the thesis that the sensory modality that provides the most accurate information will dominate the percept created by the brain. Vision is considered the most accurate source of information about spatial relations, and spatial ventriloquism provides some evidence for this hypothesis. The sight of the moving mouth dominates the auditory information. Hearing, by contrast, is judged the most accurate modality regarding temporal relations. Are there cases, then, of sound altering one's visual impressions in time like those of sight altering one's auditory impressions in space? Are there cases, that is, of temporal ventriloquism?

Researchers have recently discovered many such cases. In Fendrich and Corballis 2001, subjects were asked to judge when a flash occurred by stating the clock position of a rotating marker. Preceded by a temporally proximate audible click, the flash was seen earlier; followed by a temporally proximate audible click the flash was seen later. The one stimulus "captured" the other, bringing them closer together in time. Many researchers now have found similar phenomena (see e.g., Morein-Zamir, Soto-Faraco, and Kingstone 2003, Spence and Squire 2003). The interesting thing about temporal ventriloquism for us is that it is one quite dramatic mechanism whereby the brain can maintain a perception of synchrony even with quite asynchronous inputs; there is even evidence that the effect optimizes the chances of matching stimuli from the same event (Alais and Burr 2004).

Motor-Sensory Recalibration

Another type of mechanism the brain may employ is not the capture of one input by another, but the stretching and recalibration of the simultaneity windows themselves. We'll begin with one that is not audio-visual, and then describe two that are.

There is a large body of data supporting the claim that the phenomenal experience one has depends in part on one's intentions. For example, one cannot normally tickle oneself. The intention alters the experience. Surprisingly, recent experiments have suggested that one's experience of synchrony—of two things happening at the same perceived time—changes when intentions are involved. In one experiment (Cunningham et al 2001), subjects moved a mouse that caused a spot on a computer screen to move. Gradually a lag between the movement of the mouse and the resulting effect on the screen was introduced. Subjects informally reported that soon their actions and effects were subjectively simultaneous again. (Incidentally, the experimenters then suddenly shut off the lag, and the subjects reported that the effects on the screen occurred before they moved the mouse!) Haggard et al 2002 then set about testing directing whether this was so; whether, that is, a subject's intentions affected the *experience itself* of what things happen simultaneously. They confirmed that it did. See Eagleman and Holcombe 2002 and Stetson et al 2006 for more work and discussion.

Cross-Sensory Recalibration

Vroomen et al 2004 and Fugisaki et al 2004 show similar recalibration effects, but this time caused by cross-sensory influence rather than motor control. In Vroomen et al's experiments, subjects were presented with a succession of sounds and light flashes with different lag times in between. By questioning subjects the point of subjective simultaneity is estimated for each. Subjects then were exposed to a fixed audiovisual lag for a few minutes. It was found that the audio-visual asynchrony shifted the point of subjective simultaneity in the direction of the lag. That is, after subjects were exposed to sound before light pairs, they adapted to this; to judge the two as simultaneous the experimenters had to present the sound earlier than the light. Fugisaki et al 2004 make plausible that this "lag adaptation" is an adaptation in sensory processing rather than cognitive processing by showing that the lag adaptation changed the temporal tuning of a hearing-influenced visual illusion. They claim that their findings "suggest that the brain attempts to adjust subjective simultaneity across different modalities by detecting and reducing time lags between inputs that likely arise from the same physical events" (773).

Distance-based Recalibration

Perhaps the most striking instance of simultaneity recalibration is an example where the brain seems to take into account target distance (Sugita and Suzuki 2003; see King 2005 for discussion). In the experiment subjects were presented through headphones bursts of white noise (10ms duration) to

simulate external sound from the frontal direction. Brief light flashes were produced by a uniformly spaced array of 5 green LEDs at different distances (1-50m). The intensity of light was altered so as to produce consistent intensity at the eye. Subjects were then asked to imagine that the LEDs were the source of the light and sound, while listening to sound directly from source. To estimate subjective simultaneity, observers judged what came first, light or sound. The fascinating result is that subjective simultaneity increased by about 3ms with each 1m increase in distance up to about 40m. Now, as it happens, sound travels 1m/3ms at sea level and room temperature. Coincidence? Sugita and Suzuki think not and claim that the "results show that the brain probably takes sound velocity into account when judging simultaneity" (911).

Variations on this experiment have not always reproduced simultaneity recalibration as a function of target distance. Why this is so is an open question. Taking into account target distance would seem to be a computationally complex task, so there are probably various "rules of thumb" and/or proxies for target distance employed by the brain. The question is then what heuristics the brain uses to tell whether inputs are likely from the same source. Zambini et al 2005 show that one very natural strategy is in fact used, namely, they show that subjects are more likely to report stimuli as simultaneous when they originate from the same spatial location than when they come from different spatial positions. In any case, this effect, like the lag exposure effects described above, suggest the existence of malleable windows of simultaneity.

Flash Lag Effect

Finally, it's worth mentioning that the temporal integration mechanisms sometimes work in surprisingly odd ways. These mechanisms are not always successfully reproducing the objective temporal relations.

In the flash lag experiment, an annulus moving clockwise traces out a circle on a computer screen. At 9 o'clock on the path, a small light quickly flashes (for .001s) dead center in the annulus. What we see, however, is a flash that lags behind the moving object, opposite the subsequent direction of motion. The flash is well in the lower half of the disk. This effect has long been known. What has not been known until recently, however, is that if instead the disk "bounces" down at 9 o'clock, one sees the flash in the upper half of the annulus. In general the flash lags in the direction opposite the subsequent direction of motion. When two retinal images are aligned, continuously moving objects appear to lead flashed objects. What is remarkable is that the magnitude and direction of the experienced flash depends on what the moving annulus does *after* the flash. That is, the experience *of* t_1 *at* t_3 seems to depend on events at t_2, where $t_3 > t_2 > t_1$. This kind of phenomenon is very robust across a variety of different

experimental set-ups. Some have also claimed it is manifest in the blinking lights of planes at night and possibly even an asymmetry in offside calls in soccer.

The flash lag effect and variants (also in different sensory modalities) has recently received an enormous amount of attention in cognitive science and is the subject of a variety of competing explanations. The subject is rife with controversy, both in philosophy (e.g., Dennett and Kinsbourne 1992 on the related color phi example) and in cognitive science. In the latter, a slew of possible theories have been offered. Possible mechanisms include differential neural latency, spatial extrapolation, attention, spatial averaging and postdiction. See, e.g., Eagleman and Sejnowski 2000 and references therein. To get a sense of the explanations, the first one mentioned claims that flashed objects take longer to reach awareness than non-flashed continuously moving objects, and the last holds that the visual system uses positional data about the annulus after the flash when making its perceptual decision about what happened at the moment of flash.

Discussion

Despite the flash lag effect, it's clear that there a "reconstructive process . . . that is able to resynchronize asynchronous signals by taking into account many factors, both internal and external, which would otherwise distort accurate knowledge of timing" (Harris et al forthcoming). Perhaps, as Harris et al suggest, there is a three-stage process. First, stimuli are fit into various temporal windows. The inputs in these windows are the candidates for recalibration. Second, unfamiliar stimuli are delayed according to fixed rules (say, 40ms delay for sound to be bound with light plausibly from the same source). And third, for familiar stimuli often experienced from the same target, a more fine-grained delay is used. This process might try to erase a lag as two stimuli are experienced together more and more frequently.

Finally, I would be remiss if I didn't point out some shortcomings of the above account. First, the neural basis of the mechanisms is not clear, but it is an active area of research. It is not known whether the mechanisms are bottom-up, i.e., operating on neural transmission speeds, or top-down, i.e., operating at the "decision point" after this information is already transmitted to wherever the binding occurs. Second, we've restricted ourselves to vision and audition, but in fact there are tactile-vision and/or tactile-audition versions of virtually all of the phenomena mentioned above (see, e.g., Harris et al).

VI. Conclusion

The temporal integration mechanisms discussed above weld together as present information from events over various spatiotemporal distances. These

spatiotemporal regions are well suited to play the role the local nows do in our time stamp version of the theory. Interestingly, these spatiotemporal patches are not of fixed distance. The distance recalibration mechanism of Sugita and Suziki, for instance, seems to cease operation after the target is 40m away; moreover, only certain stimuli activate it. We don't yet know the full story. But clearly—and crucially—the patches will overlap considerably with the people and objects with which we regularly interact. It manages this feat despite the point of subjective simultaneity varying considerably among different subjects. In Stone et al's experiment, two of the subjects differed by as much as 171ms. But with integration windows as wide as 250ms, light so fast, auditory processing so speedy, and macroscopic objects changing properties relatively slowly, these differences—which are detectable—won't often be noticed in daily life. The differences between us aren't enough to undermine the idea that we share a common now; rather, the similarities among us enforce this idea.

How does our work relate to the tensed versus tenseless time debate? The detenser now enjoys the beginnings of a theory that accounts for the persistent belief that we inhabit a metaphysically distinguished present but not here. The theory is no piece of "socio-biological mythology," as Craig (2000, 156) derides the tenseless explanation of another phenomenon, the value asymmetry. Rather it is an independent product of some of our best (and most exciting) cognitive neuroscience and physics. Much remains to be learned about temporal integration. However, we already have enough to block the hypostatization of the felt present.

To be clear, I am not saying that the temporal integration mechanism is the whole story explaining why a common now but not a common here tempts us. If I were, then one might try to counter the argument by pointing to similar spatial mechanisms. The spatial counterpart of a temporal integration mechanism is a process that welds together inputs arriving at different spatial locations into one unified percept.[6] Clearly we employ such mechanisms, even if only in the forming of one percept from information going in two eyes or two ears. These mechanisms are different, but they are there. The full story, as described above, also makes use of the one-dimensionality and directionality of time, in addition to the speed of communication and the creation of presentness patches.

In sum, once distracting features of temporal indexicals are cleared away (as in section II), there is very little in experience suggestive of a tensed present. What remains is an asymmetry between our beliefs about the now and the here. We endow the now with significance that we do not accord to the here, and perhaps even believe that we are experiencing a global unique distinguished present. A good tenseless theory ought to explain why we have this persistent belief. The account offered here claims that (a) because we cannot freely explore the temporal dimension (or in relativity, timelike directions) like we can the spatial and (b) because we share similar temporal

integration mechanisms that take advantage of the rapidity of signals from the environment (but aren't so fine as to notice the relativity of simultaneity), we are led to endow the stimuli we group together as present with extra significance. In short, experience makes it easy to confuse the egocentric now with something objective in a way experience doesn't allow that with the egocentric here. We began the paper claiming that traditionally the tensed theory's best case came from experience and that the detenser's explanation of experience looked comparatively hollow. Now, with the "best case" exposed as empty and a whole lot of experiential data now unaccounted for by the tenser, it appears that the roles are reversed.

Notes

1. I confess that I'm not convinced all of the debates between so-called "tensed" and "tenseless" theories are genuine; see my "Time's Ontic Voltage" and references therein. But I am confident that there is a genuine controversy between those who want to supplement or correct the temporal relations posited by natural science and those who don't. Since this division mostly tracks the standard one, I'll retain the monikers "tensed" and "tenseless" for the sake of conformity with the literature.
2. Throughout history there were dissenters to this view, but I believe they always represented a minority opinion. Advocates of a finite velocity of light include Empedocles, Avicenna, Alhazen, Roger Bacon and Francis Bacon.
3. Incidentally, it is a striking and robust finding that after a few more ms, a subject can tell that there are two clicks, yet she cannot tell which one came first. The order threshold, the minimal interval between two stimuli at which one can discern which came first, comes much later, at around 20ms.
4. Subjectively perceived simultaneity is measured with either "points of subjective simultaneity" (PSS) or "temporal order judgments" (TOJ). PSS is determined by asking subjects to make a forced choice about whether two stimuli are simultaneous or successive. These decisions are plotted as a normal distribution, with "number of times subjects said simultaneous" plotted against the stimulus onset asynchrony (SOA) between the two stimuli. The curve's peak indicates what SOA is the most likely one for subjects to answer "simultaneous." A TOJ, by contrast, presents two stimuli at different SOA's and asks subjects which one came first. When subjects perform at chance levels, they cannot tell which one came first and this time is understood as the point of perceived simultaneity.
5. The narrow range implied by (a) and (b) should not be considered fixed. The intensity and contrast of the stimuli can affect the response latencies of nerve cells, as can the place of stimulation upon the retina in the case of sight. In the case of sound the signal speed from the target also varies.
6. The reader may be tempted to think the counterpart of "simultaneity constancy" is the phenomenon known as location constancy. Location constancy refers to the fact that objects generally seem to stay in the same place as you move your head around. However, simultaneity constancy is a mechanism that welds together two inputs emitted at the same time from the target event which arrive at distinct

times; so a spatial counterpart is not location constancy but a mechanism that welds together two inputs emitted from the same location but that arrive at different locations. In Fig. 2, it is a mechanism that welds together inputs 1 and 2 instead of 1 and 3.

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