INVITED PAPER

Precognition at the Boundaries: An Empirical Review and Theoretical Discussion[1]

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Abstract: The rigorous scientific study of precognition, the human ability to accurately predict future events that are not already predictable based on information about the past or from the five senses, spans the last 90 years. This review describes different types of precognition, underscores the basic principles of precognition research, and discusses the evidence for and potential mechanisms of two very different forms of precognition: 1) mostly unconscious precognition with short lead times (e.g., presentiment) and 2) mostly conscious precognition with longer lead times (e.g., precognitive remote viewing). I describe two potential models to explain each of these forms of precognition, along with ideas for empirical tests of each one.

Keywords: precognition, presentiment, remote viewing, precognitive remote viewing, predictive anticipatory activity, anomalous cognition

Highlights

- Precognition is the scientific term for physiology, behavior, perception, and cognition that seem to reflect future events not currently predictable by usual means.
- There are many kinds of precognitive phenomena, but two are described in detail: Presentiment (physiological precognition) and precognitive remote viewing (perceptual and cognitive precognition).
- Presentiment and precognitive remote viewing have very different characteristics, suggesting distinct mechanisms.

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- A physical-time-symmetry (PTS) model may explain presentiment but a pervasive-universal-consciousness (PUC) model may be required to explain precognitive remote viewing.
- Each model has testable elements and is therefore falsifiable.

For centuries, the ancient and indigenous idea that we might be able to navigate life by obtaining information from the future has been intriguing to Western mystics and psychologists alike. For example, Rabbi Moses Luzzatto, an 18th century Italian mystic, spoke clearly about how he felt intuition (particularly prophetic intuition) and intellect were related. He stated that, "...one should naturally be able to teach himself, understand and reason with his intellect...However, there exists another means of gaining knowledge that is much higher. This is what we call ruach ha-kadosh [the spirit of the holy one]...In this manner one can gain knowledge that could not otherwise be gained through logic alone. This includes information including future events and hidden secrets" (Hoffman, 2010, p. 54). More recently, the foundational 20th century psychologist C. G. Jung spoke about precognition in a way that brings to mind the classically non-intuitive behavior of quantum particles. "As the relativity of time and space includes the relativity of causality, and as the psyche partakes of relative time-space, it also relativizes causality and therefore enjoys, in so far as it is microphysical, an at least relative independence of absolute causality. (Chinese philosophy says that as long as things are in the North-East, i.e., before they have risen, they can be altered. When they have entered the East, they take their unalterable course)." (Jung, 1973, p. 364).

The relatively modest modern controlled experimental study of precognition began with J. B. Rhine in the 1930s (for a review see Mossbridge & Radin, 2018) and has continued to ramp up at a non-continuous pace (Figure 1), with discontinuities punctuated by the U.S. intelligence community's classification (1972) and declassification (1995) of what became their "Star Gate" program focused on accessing distant information in time and space (for a review see Marwaha & May, 2018). The pace of precognition research has quickened a bit in recent decades, but this is also when the phrase "precognitive processing" began to be used by some artificial intelligence researchers, cognitive scientists, and neuroscientists to refer to unconscious processing, though "preconscious processing" has been the more commonly used term. In the previous century (1900 to 2000), there were only eight references to "precognitive processing" within the text of any materials indexed by Google Scholar, with the earliest in 1978 (Michon). From 2000 to 2020, there were 31. Thus, in Figure 1 all papers with "precognitive processing" in the title have been excluded from the counts. Because of the need for this disambiguation, it is worth re-stating that the classical definition of precognition refers to cognition, perception, behavior, or physiology that reliably predicts future events that are not otherwise predictable by actually causing the event (direct cause), via sensory input from the known five senses, or inferring the event based on prior information.

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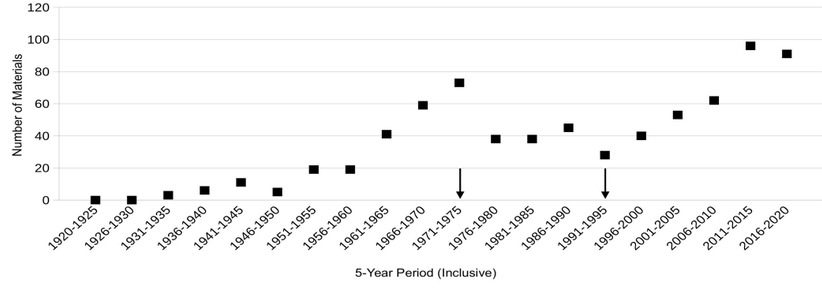
Figure 1

Scholarly Materials with Titles Containing "Precognition" or "Precognitive" but not "Precognitive Processing"



Note. Arrows note the dates of the beginning (1972) and end (1995) of the U.S. intelligence community's research program investigating the usefulness of precognition as well as other related phenomena.

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Although interest in precognition arises because it is common to have experiences in which we feel that we have predicted future events, not all types of experiences that seem precognitive are actually precognitive or easily examined in the laboratory. Precognitive experiences (Figure 2) range from those in which people are completely conscious of the contents of the precognition, like precognitive remote viewing, to those in which there is usually no conscious awareness of the precognition, like physiological presentiment (also called predictive anticipatory activity or PAA). The time between the physiological change, perception, or action marking the precognition and the event that is "precognized" (i.e., the "lead time") also distinguishes types of precognition. Behavioral precognition, such as the type studied in the famous "feeling the future" experiments (Bem, 2011), is also mostly unconscious and operates on a similar time frame as presentiment, but the effect sizes are less robust than for presentiment (see Bem et al., 2015 vs. Mossbridge et al., 2012). Compulsive precognition describes when someone knows they must take an action but they do not know why, one of the many types of psi-mediated instrumental response (PMIR) described by Stanford (2015). Compulsive precognition is spontaneous and very impressive to those who experience it (e.g., soldiers who evade danger by taking a seemingly circuitous detour), but it has not been often studied experimentally. This may be because the need context may be critical to the manifestation of PMIR in general (Stanford, 2015), and it seems that few researchers consider need as a motivator in their laboratory experiments.

Forced-choice conscious precognition tasks, in which a participant must consciously predict a target from a finite set of possible future stimuli, often have lead times on the same order as compulsive precognition (seconds to minutes), but they are much easier to study in the laboratory. Forced-choice precognition is replicable, but the results of these experiments tend to have very small effect sizes (Honorton & Ferrari, 1989; Storm et al., 2012). The small effect sizes may arise partially because participants get bored with repeated trials, and partially because conscious deliberation (also called "system 2") overshadows the continuous activity of unconscious intuitive decision making (also called "system 1"; Kahneman, 2011; Tressoldi, 2013). Finally, while precognitive dreaming is the most commonly reported precognitive experience (Rosenberg, 2016), controlled tests of precognitive dreaming have been few and far between (Mossbridge & Radin, 2018). In early studies producing significant and replicable results, a pre-screened skilled participant was used as the dreamer (Krippner et al., 1971, 1972). Since that time, the combined results of controlled precognitive dreaming experiments have been less impressive than in the foundational study (though still significant), and equivocal in the last 20 years (Storm et al., 2017). The mismatch between the commonality of the experience of precognitive dreaming and the capacity to reveal precognitive dreaming with well-controlled methods may be a result of most people's ability to connect their dream content to future events even when there is only a very weak relation between them, giving them the belief that they are skilled at precognitive dreaming and providing motivation to enroll in precognitive dreaming experiments.

As a result of these caveats about other forms of precognition, it seems that the precognitive experiences at the extremes – presentiment (or PAA) on one hand and precognitive remote viewing on the other – may be the easiest to study in controlled experiments. By studying the factors that influence these "boundary precognition phenomena," we may be able to shed some light on the mechanisms underlying precognition in general. The remainder of this summary is written with that hope.

Empirical examinations of precognition in controlled experiments require only three fundamental steps. The keys to a rigorous test of precognition include: the proper order of the three steps of the experiment, good selection of experimental stimuli, and sound data analysis. The proper order of the three steps of the experiment is: 1) record the dependent variable(s) (physiology, behaviors, cognitions, perceptions) for a pre-planned period of time, 2) randomly select a stimulus or target from a pool of stimuli or targets and

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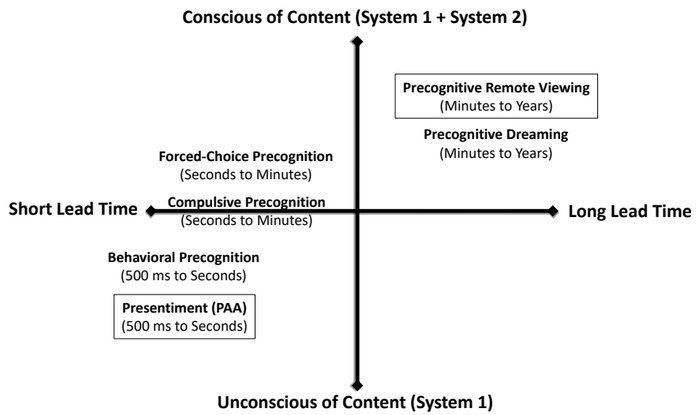
present it, 3) determine whether the values of the dependent variable(s) are correlated to different types of stimuli/targets in some predictable way. Note that the final determination of the relation between the dependent variable and the stimulus or target could also be made prior to the selection of the stimulus, as a way to discover whether the stimulus can be predicted on a trial-by-trial basis. This requires performing the same experiment multiple times so that a relation between the dependent variable and the stimulus type can be inferred (e.g., Tressoldi et al., 2009).

The best practices for all three steps of a precognition experiment depend on the systems being studied (human vs non-human; physiology vs behavior vs cognition vs perception) and what is already known about how those systems respond to the selected stimuli. Here I will treat presentiment and precognitive remote viewing as case studies in precognition research and consider what the results of presentiment and precognitive remote viewing experiments teach us about the mechanism(s) underlying precognition.

Figure 2

Six Common Types of Precognition in Humans



Note. Types of precognition are organized according to the lead time between the precognitive experience and the related future event ("lead time," *x*-axis) versus the level of consciousness of the content of the precognitive experience (*y*-axis). Boxes indicate the two extreme cases examined in greater depth in this article. PAA=predictive anticipatory activity.

Presentiment

Presentiment is a physiological form of precognition. In presentiment experiments, the physiological system under study is tested to determine whether (and sometimes how) it can predict future randomly selected events of importance to the organism. Because it is a physiological phenomenon, the actual contents of what is predicted – the presentiments themselves – are usually completely unconscious. In the laboratory, presentiment is often studied by using conscious behavioral tasks during which researchers record the unconscious physiological system of interest. The lead time in a presentiment task between the physiological "pre-response" that correlates with a future stimulus and the future stimulus itself ranges from around 0.5 to 15 seconds; two meta-analyses have estimated an effect size for presentiment at around 0.21 to 0.28 (Duggan & Tressoldi, 2018; Mossbridge et al., 2012). Presentiment has been described in multiple physiological systems in humans and animals alike (human: Mossbridge et al, 2012; see Mossbridge & Radin, 2018 for review; nonhuman presentiment-like phenomena: Alvarez, 2010a,b; Alvarez, 2016; Mothersill et al., 2018; Sheldrake & Smart, 2000; Wildey, 2001). There is some tentative evidence of similar phenomena among physical systems (Moddel et al., 2011; Mossbridge, 2021), supporting the idea that presentiment and rapid time-frame precognitive effects reflect an organism's exploitation of physical mechanisms that allow for some sort of retrocausality or time symmetry (see *Hints About Mechanism*, below).

Although there are many presentiment experiments to examine in more detail (for reviews see Duggan & Tressoldi, 2018; Mossbridge et al., 2012), briefly highlighted here are three experiments from my laboratory in which I examined presentiment as measured by three physiological dependent variables: EEG (electroencephalography or brain wave activity), GSR (galvanic skin response or skin conductance), and IPI (inter-peak interval, related to the inverse of heart rate). These different but related experiments also serve to illustrate some of the methodological issues that can arise as experimenters attempt to

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eliminate potential confounds. The readers should note that the GSR and IPI results have not been peer reviewed yet, but they may be instructive nonetheless. Some statistical analyses are shown, but where appropriate the reader is also warned that these are unpublished analyses, so they should be taken as preliminary.

Electroencephalography (EEG)

Non-emotional auditory and visual stimuli were used in a series of 100 simple response trials performed by 40 participants. On each trial, participants saw a number 1 vs. a number 2 on a computer monitor, or heard a low vs. a high tone over headphones; stimulus order was randomized. Participants were asked to press the left button on a mouse if they saw the number 1 or heard the low tone, and the right button if they saw the number 2 or heard the high tone (all participants were right-handed) (Mossbridge, 2017). Because accuracy was easy to obtain with this simple task, participants were asked to be as fast and as accurate as they could be, as a way to motivate presentiment of the response, if it existed. A machine learning algorithm determined whether the current source density-transformed EEG activity in any of the five 25-ms bins *prior* to the time the software presented the stimulus could predict whether the future response should be a left or right button press. The same method was used to determine whether the modality of the stimulus (auditory or visual) could be predicted. The presentiment effect was that the left vs. right response press was predictable based on left frontal and right temporal-parietal activity at approximately 550 ms prior to the stimulus presentation, $p < 1x10^{-6}$; intriguingly, this effect was at the same time period that a type 1 readiness potential would be expected in this sort of task (Libet, 1999). Meanwhile, the same method was not successful in predicting the stimulus type (auditory or visual), only the participants' responses. If these results were replicated with a true random number generator selecting the stimuli, it would offer stronger evidence that the type 1 readiness potential in fact is predictive of future responses in a general sense, even in situations where those future responses rely on stimuli that have yet to be determined.

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Galvanic Skin Response (GSR)

Skin conductance responses and related pre-responses to feedback were investigated in a 4-option forced-choice precognitive guessing task, with the future contrast being correct vs. incorrect trials. The major result was a gender difference, with men showing a significant arousal presentiment effect that matched their skin conductance responses after they learned that they were correct (versus incorrect; data in Mossbridge et al., 2012). Because of concern about expectation bias due to possible physiological effects of previous trials (Dalkvist et al., 2014), only the initial trial of each participant's 40-trial dataset was examined. The effect grew stronger in this single-trial analysis, showing a significant gender interaction with correctness ($p < .004$, $\eta^2 = 0.016$; unpublished analysis) as well as a significant presentiment effect for men during the 10 seconds prior to learning about the first trial's correctness ($p < .005$, $d = 0.359$; unpublished analysis). Specifically, men showed significantly increased arousal prior to being told that their guess was correct, whereas women showed (if anything) decreased arousal prior to being told that their guess was correct. It was intriguing that with a single trial the original gender difference effect became even clearer, suggesting that additional trials muddied the effect. Further, it was apparent that the physiology in the pre-feedback period in both genders echoed the post-feedback period. It was not the stimulus (correctness vs. incorrectness) that influenced presentiment – it was the nature of the response that was correlated with the pre-response.

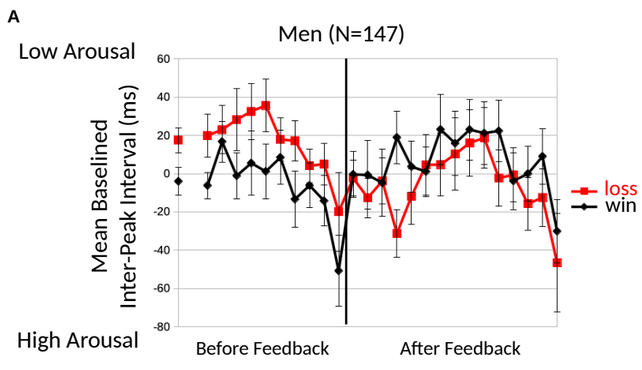
Heart Inter-Peak Interval (IPI)

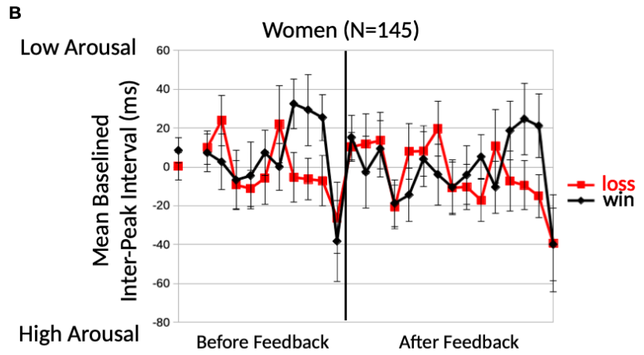
In this experiment I tested the idea that the skin conductance result described above would replicate with an inter-peak interval (IPI; inverse of heart rate) measure instead of skin conductance, and with a downloadable app instead of in the laboratory (Koestler registry 1005). The "Heart Tracker" application measured inter-peak intervals using a smartphone's camera during the ~10 seconds before and 15 seconds after

participants learned whether they correctly identified a "door" behind which was a $2 dollars prize. The analysis, which was pre-registered, showed an effect similar to the skin conductance effect described above (Figure 3a,b), with an equivalent gender interaction and a significant effect for men in the 10 seconds prior to the feedback (men: N = 147, p < .04, d= 0.36; gender interaction: N = 292, p< .04, η^2 = 0.016; unpublished analysis). However, a follow-up study (Koestler registry 1018) using a $4 dollars reward did not replicate these effects, potentially because the pre- and post-feedback durations were too brief to capture what is likely a much larger and delayed post-response to the feedback (already apparent for men in the $2 version of the experiment; Figure 3a; unpublished analysis). The idea that some form of time symmetry can explain presentiment (e.g., Bierman, 2008) could be considered to be weakly supported by this lack of replication – but this interpretation would require an experiment showing that the effect is recovered with longer data collection periods before and after feedback.

Figure 3

Inter-Peak Interval (IPI) Heart Rhythm Data Gathered Using a Smartphone App





Note. Data are baselined to the first IPI value (not shown). The values at the left of each graph are the grand means of the baselined IPI values in the 10 seconds prior to receiving feedback for wins (black symbols) and losses (red symbols) revealed at the time indicated by the vertical line. Error bars represent +/- 1 standard error of the mean (S.E.M.).

Presentiment and Behavioral Precognition

Presentiment and behavioral precognition operate at a similar time frame and are mostly unconscious, albeit with most behavioral precognition tasks requiring a bit more conscious attention than most presentiment tasks. So, it is natural to assume that presentiment mechanisms underlie performance on behavioral precognition tasks. If this assumption were true, what conclusions could we draw about the shared mechanisms governing both types of precognition performance?

In particular from the GSR and IPI presentiment studies highlighted above, one might conclude that if gender is indeed related to differential presentiment performance, it ought also be related to differential behavioral precognition performance. This idea was tested using two behavioral precognition tasks requiring two different degrees of consciousness of the content of the precognition (Mossbridge & Radin, 2021). They both showed significant overall effects, but gender differences were only found for the largely unconscious behavioral precognition task rather than for the task that required more conscious awareness, suggesting that there might be something about largely unconscious processing that is influenced more readily by gender differences.

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Although these gender difference results, especially among mostly unconscious precognition tasks, could reflect gender-specific learned associations with "winning," they may alternatively suggest that reproductive hormones could be involved in precognitive processing, especially for the brief time frames influenced by presentiment and behavioral precognition. An examination of the reproductive hormone idea used a retroactive facilitation of recall task (Bem, 2011) – a behavioral precognitive learning task with a relatively long lead time (minutes). An investigation of data from over 2,000 online participants found no overall effect, no gender difference, and no consistent effects of reproductive hormones except for an under-powered observation of consistently better performance for pregnant women (Mossbridge & Bem, 2018). It is possible that the long lead time for this task in particular may drive participants into a more conscious or deliberative state, making the effect difficult to obtain (Bem et al., 2015),

Overall, current results suggest that performance on presentiment and behavioral precognition tasks can be influenced by gender, perhaps through a mechanism involving reproductive hormones, among other possibilities. Further, it appears that pre-responses prior to a stimulus tend to match or predict post-responses, rather than matching or predicting the nature of the stimuli themselves. This particular phenomenon, as applied to presentiment, is almost like a "time loop" in that it often appears that the response rather than the stimulus is what drives the pre-response (Wargo, 2018; see *Hints About Mechanism*, below). Finally, it is worth noting that for presentiment and behavioral precognition tasks in which one trial follows the next, shorter inter-trial intervals may muddy the effect because past responses (and conceivably future ones) will likely influence responses on a given trial. Thus, for these phenomena it is possible that the best approach when trying to understand the mechanisms underpinning them is to examine single-trial datasets to determine the relations, if any, between presentiment and potential moderating factors (Dalkvist et al., 2014).

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Precognitive Remote Viewing

Precognitive remote viewing is a form of precognition performed as an extended, conscious, 1-trial task with the intention of describing a target or the answer to a question that is unknown by anyone at the time of the task and is revealed in the future. As such, precognitive remote viewing tasks are a subset of general remote viewing tasks, in which practitioners attempt to describe information that is distant in time and/or space (e.g., May & Marwaha, 2018; McMoneagle, 2015; Utts, 1995). A precognitive remote viewing session can take between two minutes and two hours at the discretion of the "viewer," who is the percipient or participant in the task. The delay between the session and the target feedback may be from minutes to years, or in certain operational cases there may not be any target feedback shared with the viewer. For instance, if an intelligence or law enforcement agency feels that revealing a target will compromise a project, they may choose not to reveal the target.

Precognitive remote viewing tasks are excellent candidate tasks for scientists interested in understanding how various factors relate to precognitive ability, because a viewer's capacity for accuracy is often revealed in the very first session performed by a novice viewer (Targ, 2019), making single-trial work generally more consistent (less noisy) than that of physiology or behavioral experiments. This also allows the possibility of online data gathering for precognitive remote viewing experiments from hundreds of people, a sample size necessary to rigorously examine the relations between relevant factors and precognition performance (Mossbridge & Radin, 2018; Mossbridge et al., under review).

Ever since the U.S. intelligence community declassified its work on remote viewing and precognition in 1995, remote viewing practitioners have experimented with multiple methods to improve their accuracy. Drawing from the relatively well-controlled experiments included in the intelligence community-sponsored research and anecdotal reports, a few particular claims are repeated with regularity. Here I review four of these claims and briefly describe recent well-controlled experimental evidence related to them.

Gender Difference

The first claim is that, unlike what appears to be the case for presentiment and behavioral precognition tasks (Bierman & Scholte, 2002; Lobach, 2009; Mossbridge et al., 2012; Mossbridge & Radin, 2021; Radin & Lobach, 2007; Wittmann et al., 2021), there is no clear gender difference when it comes to precognitive remote viewing accuracy. In recent work on precognitive remote viewing examining trials gathered online, there was a gender effect only in an experiment in which the precognitive remote viewing task included a forced-choice component (Mossbridge et al., under review). Specifically, when participants were asked to choose one of two targets based on their remote viewing session, men performed better than women although accuracy was not above chance for either gender. However, when a more traditional free-responses precognitive remote viewing task was used, there was an overall significant effect but no significant gender effect in performance; only a very slight tendency for women to perform better than men.

Feedback

Remote viewers working with law enforcement or with targets classified beyond their clearance level claim that feedback is not necessary for them to perceive accurate information about the target (McMoneagle, 2015) – whereas remote viewers working to predict targets associated with financial markets claim that feedback is crucial (Katz et al., 2021). The role of feedback is key when it comes to understanding the mechanisms underlying precognition, because if feedback is not necessary for accurate performance, then the idea that a person is pre-responding to their own future experience cannot correctly describe the situation. For forced-choice precognition experiments, meta-analytic results indicate that trial-by-trial feedback supports accuracy (Honorton & Ferrari, 1989), so it is not unreasonable to assume the same would be true for precognitive remote viewing. Nonetheless, the role of feedback has only been explored in a few precognitive remote viewing experiments.

In one such experiment, the conscious availability of feedback was manipulated and was shown to have no effect on the accuracy of precognitive remote viewing for participants producing significant performance (May et al., 2014). And a related recent study showed that skilled and pre-screened remote viewers were capable of describing changes in a German stock index (DAX) prior to the realization of those changes, but there was no significant difference in their performance when feedback was available versus when it was not (Müller et al., 2019). Based on these well-controlled studies it appears that feedback may not be required for the *accuracy* of precognitive remote viewing, though it is possible that feedback supports viewer *motivation* when performing repetitive precognitive remote viewing trials.

Interesting Targets

Another often-repeated claim among professional remote viewers is that targets with high "numinosity" – that is, greater affect, more information, or more meaning – produce greater accuracy (May et al., 1994a,b; Schwartz, 2007; Watt, 1988). This claim has been tested in multiple precognitive remote viewing experiments and has been upheld (Delanoy & Solfvin, 1996, Krippner et al., 2019, Mossbridge et al., under review). In one study (Delanoy & Solfvin, 1996), video targets containing more information (and potentially therefore more interesting) were common among targets that were likely to be described well, even if they were not the selected target on a particular trial and instead were used as comparison targets and therefore only seen by independent judges. In a more recent

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study, Krippner et al. (2019) found that static image targets rated as more numinous by independent judges produced significant precognitive remote viewing performance, while lower-rated image targets did not. Further, the relation between target interestingness and accuracy was independently analyzed in three data sets (one confirmatory analysis was pre-registered, Mossbridge et al., under review). All three analyses revealed that photo targets rated as more interesting were more likely to be correctly described – even when those targets were used as comparison targets for judges and not seen by participants. Overall, it appears that precognitive remote viewing tasks are similar to memory tasks in that some feature related to the salience of the target influences accuracy. This same rule has been proposed for forced-choice and behavioral precognition tasks, but thus far it appears that target affect does not seem to have a profound impact on accuracy in these sorts of tasks (Storm et al., 2012).

Self-Transcendence

The final claim about precognitive remote viewing performance is that better performance is obtained when viewers are in a positive or expansive mood (McMoneagle, 2000; Swann, 2018). Some scientists believe that this effect is motivational because belief in the possibility of precognition and other forms of psychic phenomena impacts performance in forced-choice and behavioral precognition tasks (e.g., Mossbridge & Radin, 2018, 2021), and therefore is believed to impact remote viewing performance in general (Subbotsky et al., 2019). But in the only direct study of precognitive remote viewing in which belief was measured, belief was not shown to impact accuracy (Roe et al., 2020), providing another example of the non-equivalence of precognitive remote viewing with forced-choice and behavioral precognition tasks.

Meanwhile, the experience of being in a positive or expansive mood has been shown to be correlated with better accuracy in largely precognitive ESP (anomalous cognition) experiments conducted in a ganzfeld context (Carpenter, 2005), a context in which participants are re-focused on internal stimuli. Ganzfeld may also support an experience of self-transcendence and it seems to lead to significantly higher scoring on a free-response precognitive remote viewing task (Roe et al., 2020). Along the lines of self-transcendence, the experience of unconditional love might support better accuracy in free-response precognitive remote viewing. This idea comes from a post-hoc analysis of laboratory data showing that participants self-reporting high levels of unconditional love prior to being hypnotized to experience it performed significantly better than chance and better than participants who reported low levels of unconditional love in the same time frame (Mossbridge et al., 2021). A follow-up experiment modified to be performed online examined the relation between a measure of unconditional love and free-response precognitive remote viewing accuracy and had the same result (Mossbridge et al., under review). Together, these experiments suggest that unconditional love – or perhaps expansive, self-transcendent, altered states in general – support precognitive remote viewing. In fact, environmentally imposed self-transcendence, or what Cameron (2022) calls "alter association," may be the key to understanding why people with a high childhood history of trauma, especially neglect, have been found to score significantly better than those with a lower trauma history on a precognitive remote viewing task (Cameron, 2022).

Taken together, it appears that the four claims about precognitive remote viewing described here are supported by independent and well-controlled tests. Although these results could be overturned by the recognition of methodological flaws or the production of multiple well-controlled studies contradicting the existing results, the current data point to the following conclusions about precognitive remote viewing: 1) there is no significant gender difference in accuracy, 2) there is no significant decrease in accuracy when there is no feedback about the target, 3) viewers are significantly better at describing more interesting or information-filled targets (whether they see them or not),

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4) high self-transcendence, including greater feelings of unconditional love, produce significantly higher accuracy.

Hints About Mechanism

There are some key differences between presentiment and precognitive remote viewing, described briefly above and elaborated on below, indicating that they are distinct phenomena (Table 1). A few of the entries in Table 1 require further explanation, which I will briefly provide here. Whether feedback about the stimulus is required for presentiment to occur is a semantic question. A presentiment experiment consists of giving the participant the conscious experience of a stimulus and determining what the physiological response was prior to that stimulus, and teasing out how that response relates to the stimulus type and the post-stimulus response. Although an experiment cannot really be considered a presentiment experiment without a stimulus revealed to the participant, some scientists have examined presentiment-like responses to stimuli selected but not shown, and have been able to differentiate responses to "blocked" versus presented stimuli (e.g., Tressoldi et al., 2009). However, since a non-presentation of a stimulus versus its presentation can be interpreted as two different stimulus types, this type of experiment does not fully demonstrate that presentiment-like responses can occur without stimulus presentation.

Two other entries in Table 1 require explanation as they relate to presentiment: interesting targets and self-transcendent states. Although the comparison classes in presentiment experiments are often between emotionally engaging versus neutral targets, this does not have to be the case to get a presentiment result. What is required, it seems, is to create a situation in which the post-stimulus physiological response is different between two stimuli (Mossbridge et al., 2015). This can be done with stimuli that differ in their arousal response and therefore their level of interest to the physiological

Table 1

Comparison Between Presentiment Versus Precognitive Remote Viewing

Characteristic	Presentiment	Precognitive Remote Viewing
Mostly conscious?	No	Yes
Prediction up to years in the future?	No	Yes
Gender influences accuracy?	Probably[a]	No
Feedback required?	Yes	No
Interesting targets help?	No	Yes
Self-transcendence helps?	Not Clear	Yes

Note. [a] Indicates this conclusion would be stronger if all unpublished data described above were peer-reviewed.

system in question, or it can be done with neutral stimuli that do not differ in interestingness but differ in their meaning within the context of the task (as in examples 1 through 3 above). Thus, it is not interestingness per se but rather the contextual interpretation and response to the stimulus that determine the presentiment effect. This is best illustrated in example 1 (above), in which the EEG pre-responses predicted the participants' responses but did not predict the stimulus types themselves.

As to self-transcendence and presentiment, to my knowledge there is no experiment in which either presentiment or behavioral precognition tasks in particular (i.e., exclusive of other psi tasks, see Carpenter, 2005; Roe et al., 2020) have been examined in an environment like the Ganzfeld to examine whether self-transcendent states support these effects. Some experimenters note that meditation practice, associated with self-transcendence, can increase accuracy in some conscious forced-choice precognition tasks (Roney-Dougal et al., 2008: Roney-Dougal & Solfvin, 2011; Varvoglis, 2019), but for presentiment tasks the results may depend on the nature of the stimuli. For example, when the stimuli are from two neutral classes as in a study of EEG pre-responses to auditory and visual stimuli (Radin et al., 2011), meditators may perform

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better on presentiment tasks than non-meditators, as they may differentiate events in time less rigidly. But as Bierman (2002) noted, meditators are adept at suppressing arousal response to challenging or erotic stimuli, and this may explain worse performance by meditators on presentiment tasks in which some of the stimuli are meant to produce emotional arousal. Therefore, the jury is still out on whether presentiment effects are improved when participants are in a self-transcendent state.

Assuming that human capabilities with sharply different characteristics are likely to be served by at least partially separate mechanisms, it appears that presentiment is likely served by a mechanism that is at least partially separate from the mechanism underlying precognitive remote viewing. Although hypotheses about physical mechanisms governing precognition have been offered in the past, they have generally treated precognition as a somewhat unitary phenomenon. That is, they have either tailored their models to explain results from a particular type of precognition and no other type, or they have combined presentiment, precognitive remote viewing, and other forms of precognition into one conceptual lump (e.g., multiphasic model: Marwaha, 2018; Marwaha & May, 2015; CIRTS model: Bierman, 2008, 2018; thermodynamic retrocausal model: Sheehan & Cyrus, 2018). In contrast, an important psychological model of precognition does a good job of separating forms of precognition (Carpenter, 2004, 2005), but it primarily focuses on the relation between precognition and other aspects of unconscious processing, rather than trying to describe physically how the information revealed in precognition experiments "arrives from the future." Elements of all of these influential theories are almost certainly reflective of some aspects of each of the mechanisms underlying presentiment and precognitive remote viewing. Here very broad strokes are used to speculate about potential physical and non-physical mechanisms, including the theories mentioned already, that might underly presentiment and precognitive remote viewing (Figures 4a,b).

Presentiment and the Physical-Time-Symmetry (PTS) Model

Let us first consider the case of presentiment and other largely unconscious forms of precognition with brief lead times. The consciousness restoration of time symmetry (CIRTS) model of Bierman (2008, 2018) was designed largely to explain such presentiment results. The idea here is that the information processing during conscious awareness of a stimulus or target restores an underlying physical time symmetry to physiology, providing the retrocausal effect of presentiment. According to this idea, if there is no conscious processing of the stimulus, there is no presentiment.

Taking the CIRTS idea and imposing the physical portion of it on a completely physical system is possible, and that is what I call a "physical-time-symmetry" (PTS) model of presentiment (Figure 4a). The proposition of this toy model is that presentiment and other short time-frame, largely nonconscious precognitive phenomena act through physical time symmetry in the three dimensions of space and one dimension of time, within the human body and brain. Note that a stimulus must be present in the future to induce a post-stimulus response, but if the stimulus can induce this post-stimulus response without consciousness, then consciousness is not necessary for this model.

The PTS model is very similar to the thermodynamic retrocausal model of Sheehan and Cyrus (2018), although their model is more detailed than PTS and it suggests that precognition will be enhanced by conscious awareness of the feedback because it will boost post-feedback responding. The benefit of such a model is that only time symmetry need be proposed, a concept already available in classical physics (Sheehan & Cyrus, 2018). Further, the fact that gender and potentially hormone differences influence these unconscious, short time-frame forms of precognition is consistent with the idea that they are strictly physical in nature. Similarly, the lack of long time-frame access to information about future events is consistent with a solely physical mechanism, because physiological mechanisms responding to many forms of future input would get

exponentially noisier the greater the distance between the pre-response and the future event. Finally, the dual findings that presentiment effects seem to be retrocausal responses to future internal states of the percipient and that presentiment effects themselves are largely unconscious both support the idea that consciousness and other potentially non-physical phenomena are not required for these effects to occur.

Precognitive Remote Viewing and the Pervasive-Universal-Consciousness (PUC) Model

The multiphasic model and the thermodynamic retrocausal model are both based almost entirely on precognitive remote viewing and precognitive dreaming results. For the thermodynamic retrocausal model, feedback is required because it is the feedback itself that creates a retrocausal impact on the past perceptions of the experimental participant (Sheehan & Cyrus, 2018). In contrast, for the multiphasic model information arises from an unknown external source distant in spacetime which is transferred through sensory means to the human brain and body (Marwaha, 2018; Marwaha & May, 2015). This process does not seem to require specific feedback about the target, and various factors including information content and the state of the remote viewer can influence the reception of the information through sensory means. These features of the multiphasic model match the existing precognitive remote viewing results better than the thermodynamic retrocausal model does. However, the missing piece of the multiphasic model, as the authors themselves explain, is how the information gets from somewhere/somewhen distant in spacetime with respect to the percipient.

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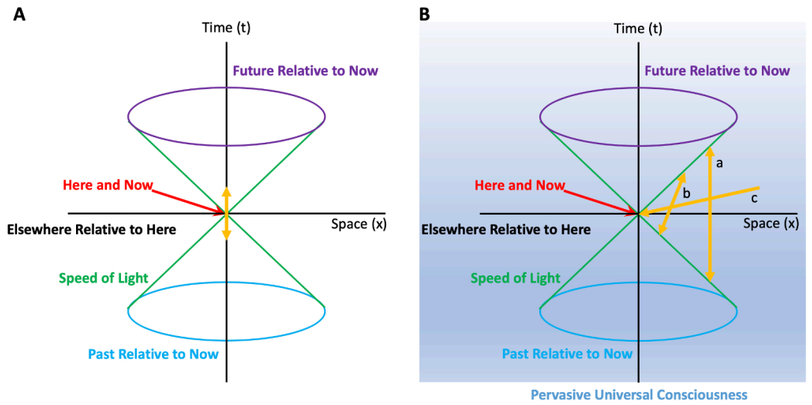
I too am unable to satisfactorily explain how information gets from somewhere/somewhen in spacetime with respect to a percipient in the here and now. I will speculate nonetheless about the mechanisms underlying precognitive remote viewing and other largely conscious forms of long lead-time precognition, with the goal of creating a testable *toy model* – that is, an overly simple model designed to ignite creativity and understanding but not meant to include all factors. I call this model the "pervasive-universal-consciousness" model (PUC; pronounced like the character "Puck" in Shakespeare's *A Midsummer Night's Dream)*.

The basic idea of the PUC model is that the source of the information retrieved by the precognitive remote viewer arises from a universal consciousness (e.g., Barušs & Mossbridge, 2017; James, 1909), an information-rich and pervasive nonlocal, non-3D, non-physical "field" not confined to an individual's local position in spacetime. If one makes the assumption that this universal consciousness permeates everything (because it is not constrained to local spacetime) and stores all the information in the universe regardless of the space or time from which it originated (e. g., Akashic records; Nash, 2019), then the question is about how information can be received, since there is so much information to be had. Within the context of seemingly limitless information, the question becomes how a viewer can receive specific information appropriate to a given precognitive remote viewing task when so much information is apparently available. This question actually has two parts: 1) how does the percipient communicate to the universal consciousness what information is needed, and 2) how does the universal consciousness provide that information?

Figure 4

Physical and Non-Physical Aspects of Two Proposed Precognition Mechanisms



Note. A) The physical-time-symmetry (PTS) toy model describing presentiment and other short time-frame, largely nonconscious precognition. B) The pervasive-universal-consciousness (PUC) toy model describing precognitive remote viewing and other long time-frame, largely conscious precognition. [a] Transferring intention from the percipient forward in time and information backwards in time to the percipient's light cone at its electromagnetic boundary.[b] The same as (a) but asymmetrically relative to "now." [c] Transferring both information and intention unidirectionally, from the pervasive universal consciousness to now.

Continuing to speculate in the service of creating a model that may eventually be falsifiable, let us assume in the PUC model that the percipient uses *intention* to communicate to the universal consciousness what information is needed. Intention as the carrier of this request is proposed for several reasons: 1) multiple anecdotal reports suggest that the success of precognitive remote viewing is driven by intention, 2) intention is a conscious experience and therefore can be thought of as having both a physical (brain/body) and nonphysical (mental) component, providing two media with which to communicate with pervasive universal consciousness, and 3) we use intention in our physical everyday actions to help us select our sensory inputs and motor actions (e.g., if I intend to eat blueberry pie I am more likely to eat blueberry pie).

In terms of how the universal consciousness provides the information, let us imagine that if the information originates outside the light cone, the information is transferred by the PUC to the electromagnetic boundary of the percipient's light cone and can, from there, be perceived by the percipient (Figure 4b). This odd assertion arises from examining a precognition-like effect in a quantum optical system (Mossbridge, 2021), in which it appears that both presentiment-like behaviors (i.e., registering the future state of the system) and precognitive remote viewing-like behaviors (i.e., registering information not in local spacetime) are being displayed by the photons in the experiment. From this comes a highly speculative proposition that light – or electromagnetic radiation – can be seen as a translator between universal consciousness and local spacetime. Although not essential to the PUC model, it is an intriguing detail that could potentially be tested (see below, *Testing the Models*).

One may reasonably ask, how does this intention piece actually work? In a precognitive remote viewing task in which no one including the experimenter knows the answer to a question being posed by the target, which is often the case in operational precognitive remote viewing (e.g., "Where is this missing child?"), the intention communicated to universal consciousness would be something along the lines of "Please get the information required for this tasking and communicate it to me effectively." For instance, if the task is to address an unknown future question that turns out to be a future scientist's query about how to create a time machine, then it is up to universal consciousness to first access the future scientist's query, find the answer to the question, and deliver the answer to the percipient. Thus, the intention provided to universal consciousness is very different from the information content coming back to the percipient. That is, there is an essential asymmetry in that the PUC knows the question and the answer and must provide it, while the percipient only holds the intention that the correct information be provided to them. Further, in the case of spontaneous precognitive dreaming in which there is no clear intention on the part of the dreamer at all, the intention and the information

seem to go in only one direction – as if the universal consciousness has its own intention as well as the information matching that intention, and these are transferred to the dreamer through elements of their dream, directly to the observer in the here and now (e.g., Figure 4b, arrow c).

The PUC toy model described here is consistent with the characteristics of precognitive remote viewing, but the universal consciousness component is of course very speculative. It is necessitated by three key results. First, precognitive remote viewing can be used to accurately describe structures, people, and events distant in space as well as far in the future and past without feedback. If a percipient never sees the feedback, this means that their "now" never consists of that feedback – placing this information outside of the light cone of the percipient. Any model explaining precognitive remote viewing must explain how information from outside of local spacetime gets into local spacetime. In other words, a wormhole or other exotic physical process must be postulated to send and receive information to the percipient, or nonphysical processes like a PUC must be considered. Second, the fact that in precognitive remote viewing tasks targets that are interesting to a viewer or more "numinous" are more likely to be described accurately than other targets suggests that there is a type of two-way communication between the percipient and the source of the information, rather than a mechanical one-way flow of information. Finally, the evidence that self-transcendent states may support accuracy in precognitive remote viewing tasks suggests that there is an aspect to the mechanism that is more accessible from a mental state that explicitly involves moving oneself beyond the boundaries of the personal, decreasing critical thinking while increasing a boundaryless state (Cardeña, 2010; Lindström et al., 2022). Absent these results related to interesting targets and self-transcendent states, several alternative and intriguing physical and mental-physical dualist models could also be considered as potential explanations for precognitive remote viewing effects (e.g., Atmanspacher, 2003, Greene et al., 2022), Thus in the PUC model, the pervasiveness and personal nature of the universal consciousness reflects primarily the target-interestingness and self-transcendence results.

Testing the Models

Testing the PTS Model

Portions of each of these two models can potentially be tested. For the PTS model, a way to elicit presentiment or at least behavioral precognition responses without de facto stimuli would be the most obvious way to test the claim that the phenomenon does not require consciousness and relies on post-feedback responses. If pre-responses associated with non-displayed feedback occurs when there are no stimuli presented (ever) within an experiment, there is no feedback of any kind (e.g., stimuli are selected but not shown), and there are no post-feedback responses (e.g., responses after the time of the non-feedback), then the physical-time-symmetry model cannot explain presentiment. In that case, presentiment would have to be explained by something like the PUC model. Another way to test the PTS model would be to introduce a general anesthetic just before a stimulus is delivered (in a single-trial experiment) and determine across participants if pre-responses matched post-responses regardless of conscious awareness of the stimulus. The PTS model predicts that if there is a post-stimulus physiological response, there should be a pre-stimulus response in the same physiological system (regardless of conscious awareness of the stimulus).

Testing the PUC Model

The first step to ruling out the PUC model would be to demonstrate methodological flaws in the precognitive remote viewing experiments showing precognitive access to information never given to the percipient. The second step would be to repeat such no-feedback experiments and find the result that feedback trials were in fact significantly more accurate than no-feedback trials. Of course, ruling out that there

is a personal and individual communication of sorts with some kind of nonlocal source of information would also be key. One experiment designed to rule out the human side of this sort of communication is to ask a group of skilled precognitive remote viewers to obtain information about the future state of someone they love versus a stranger, and to compare the accuracy of both types of sessions. If there is no difference in accuracy, the PUC model is likely wrong, because it proposes an intentional connection between the PUC and the viewer. Along those lines, although it is difficult to test whether a universal consciousness has intention toward us, it might be useful to investigate implicit and explicit human intentionality and observe how each type of intentionality influences precognitive remote viewing performance. Another feature of the PUC model is that there is no causal closure – specifically, that there is something about the pervasive universal consciousness that can influence physical reality. In the PUC model, this influence is imagined to be the electromagnetic force. If electromagnetic phenomena, including biophotons, can be tested in the presence of a precognitive remote viewing session and there is never any association between electromagnetism and session accuracy, this would suggest (but not prove) that the PUC model requires another method to transfer information from the nonphysical to the physical. And, in general, if it can be shown that precognitive remote viewing performance does not depend on intentionality, that portion of the PUC model would be incorrect.

Next Steps

Regardless of what will eventually be uncovered about the mechanisms underlying precognitioin, given existing data it appears that at least some forms of precognition will have to be explained by what is currently considered exotic physics or a nonphysical/extraphysical mechanism. As explained above, this does not mean that the PTS and PUC models are untestable, just that they may be easier to understand and rigorously test for

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those scientists who acknowledge that the scientific method itself does not rely on a materialist worldview (Barušs & Mossbridge, 2017). In the meantime, it is useful for those interested in practical applications of precognitive phenomena to keep in mind that each type of precognition might be explained by slightly different mechanisms, so understanding and characterizing the features of precognition that work best for a given application are keys to making practical progress.

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Präkognition an den Grenzen: Eine empirischer Übersicht und eine theoretische Diskussion

Julia Mossbridge

Zusammenfassung: Die streng wissenschaftliche Untersuchung der Präkognition, der menschlichen Fähigkeit, zukünftige Ereignisse, die nicht bereits aufgrund von Informationen über die Vergangenheit oder durch die fünf Sinne vorhersehbar sind, genau vorherzusagen, umfasst die letzten 90 Jahre. In dieser Übersicht werden verschiedene Typen der Präkognition beschrieben, die Grundprinzipien der Präkognitionsforschung dargestellt und die Beweise und potenziellen Mechanismen für zwei sehr unterschiedliche Formen der Präkognition erörtert: 1) zumeist unbewusste Präkognition mit kurzen Vorlaufzeiten (z. B. Vorahnung) und 2) zumeist bewusste Präkognition mit längeren Vorlaufzeiten (z. B. präkognitives Remote Viewing). Zwei mögliche Modelle werden beschrieben.

German translation: Eberhard Bauer

Precognição nos Limites: Uma Revisão Empírica e Discussão Teórica

Julia Mossbridge

Resumo: O rigoroso estudo científico da precognição, a capacidade humana de antever com precisão eventos futuros que ainda não são previsíveis com base em informações sobre o passado, ou a partir dos cinco sentidos, já abrange os últimos 90 anos. A presente revisão descreve diferentes tipos de precognição, destaca os princípios básicos da pesquisa sobre precognição e discute as evidências e mecanismos potenciais de duas formas muito diferentes de precognição: 1) a precognição fundamentalmente inconsciente, com períodos de curta duração (por exemplo, pressentimento) e 2) a precognição predominantemente consciente com com períodos de duração mais longos (por exemplo, visão remota precognitiva). Dois modelos potenciais são descritos.

Portuguese translation: Antônio Lima

La Precognición en los Límites: Una Revisión Empírica y un Debate Teórico

Julia Mossbridge

Resumen: El riguroso estudio científico de la precognición, la capacidad humana de predecir con exactitud acontecimientos futuros que no son predecibles basándose en información sobre el pasado o procedente de los cinco sentidos, abarca los últimos 90 años. Esta revisión describe distintos tipos de precognición, subraya los principios básicos de la investigación sobre la precognición, y analiza las pruebas y los posibles mecanismos de dos formas muy distintas de precognición: 1) la precognición sobre todo inconsciente con tiempos de espera cortos (por ejemplo, el presentimiento) y 2) la precognición sobre todo consciente con tiempos de espera más largos (por ejemplo, la visión remota precognitiva). Describo dos posibles modelos para explicar cada una de estas formas de precognición, así como ideas para poner en prueba empíricamente cada uno de ellos.

Spanish translation: Etzel Cardeña

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