



Prayer and Neuroimaging: Concepts and Feasibility

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Abstract

Long recognized as a defining feature of religion, prayer, paradoxically, has received only sporadic empirical attention. Recent investigations in the U.S. and the Netherlands have sought to address this gap by exploring the topic of prayer in programmatic fashions, significantly advancing the state of the art in terms of measurement of the practice of private prayer. The present paper first offers one way to integrate and expand the contemporary prayer literature using a conceptual analysis of religion. Second, challenges and possibilities associated with moving from this synthetic definition to neuroimaging work are examined within the framework of social cognitive neuroscience.

Keywords: neuroscience, prayer, theory, critique, review, methodology, social cognitive neuroscience

Słowa kluczowe: neuronauka, modlitwa, teoria, krytyka, recenzja, metodologia, społeczno-poznawcza neuronauka

Long recognized as a defining feature of religion, prayer, paradoxically, has received only sporadic empirical attention. Recent investigations in the U.S. and the Netherlands have sought to address this lacuna by exploring the topic of prayer in programmatic fashions, significantly advancing the state of the art in terms of measurement of the practice of private prayer. Specifically, Baesler¹ emphasized interpersonal communication aspects of prayer while Janssen² and colleagues evaluated motivations for praying. Additional independent efforts have reviewed and consolidated discrete ways that people approach prayer as a means of forming connections inward (with

¹ E.J. Baesler, *Theoretical explorations and empirical investigations of communication and prayer*, Lewistown N.Y. 2003.

² J. Janssen, J. De Hart, C. Den Draak, *A Content Analysis of the Praying Practices of Dutch Youth*, "Journal for the Scientific Study of Religion" 1990, No. 29, p. 99–107; J. Janssen, M.H. Prins, J. van der Lans, C. Baerveldt, *The Structure and Variety of Prayer: An Empirical Study of Dutch Youth*, "Journal of Empirical Theology" 2000, No. 13, p. 29–54; J. Janssen, S. Bänziger, *Praying as a Universalizing Variable*, "Archive for the Psychology of Religion" 2003, No. 25, p. 100–112.

their own spirit), outward (with other people), and upward (with the divine) providing evidence of the reliability and validity of the developed scales³. In other words, reliable and valid instruments exist to quantify self-reported prayer experiences.

Simultaneous with the psychometric work on prayer, researchers began exploring cognitive and neural aspects of religious experiences⁴. Many of these nascent investigations suggest that religious experiences may differ at the cognitive and neural levels from various other mental states such as relaxation. A frequent component of these protocols that use tools of modern neuroscience is the use of meditation or prayer as a mechanism to invoke physiological change. Unclear, however, are the precise nature and characteristics of the meditations or prayers that the participants utilize, rendering findings ambiguous.

The psychometrics of prayer and the neuroscience of religion are coming of age rapidly and interdisciplinary research linking the fields will help expand their investigative spheres. Prayer research could be significantly advanced by moving into a realm where self-report is augmented by physiological data. Likewise, the neuroscience of religion will benefit from the introduction of psychometrically sound definitions of the phenomenon under exploration.

The present work outlines the challenges and possibilities associated with the development of a protocol for merging these two streams of inquiry. In this paper, we evaluate concerns from theoretical and theological to pragmatic (e.g., human vs. computer generated stimulus), indicating their respective benefits and challenges in order to set the stage for a discussion concerning “best practices” in the area.

The application of neuroimaging techniques to the study of prayer experiences will surely strike some people as thoroughly sacrilegious and others as purely ludicrous⁵. We are well aware of both varieties of criticism and hope in the following paper to convince, if not outright convert, at least a few of the skeptics that such interdisciplinary work has merit despite its perceived substantial limitations.

To that end, we believe it is imperative to begin by clearly delineating our vantage points with respect to both prayer and neuroimaging. These terms have many meanings within their native areas of practice and it is our desire to be as precise as possible.

³ K.L.Ladd, B. Spilka, *Inward, Outward, Upward: Cognitive Aspects of Prayer*, “Journal for the Scientific Study of Religion”, 2002, No. 41/3, p. 475–484; K.L. Ladd, B. Spilka, *Inward, Outward, Upward Prayer: Scale Reliability and Validation*, “Journal for the Scientific Study of Religion” 2006, No. 45/2; K.L. Ladd, M.L. Ladd, P. Ashbaugh, D. Trnka, J. Harner, K. St. Pierre, T. Swanson, *Inward, Outward, Upward Prayer and Personal Character*, “Research in the Social Scientific Study of Religion”(special section on Positive Psychology, Religion, and Spirituality) 2007, No. 18, p. 209–231; K.L. Ladd, J. Harner, T. Swanson, T. Metz, K. Haubold, D.T. Trnka, *Inward, Outward, and Upward Prayer: Links to Personality (Big Five)*, “Archiv für Religionspsychologie” 2007, No. 49, p. 151–175.

⁴ N.P. Azari, J. Missimer, R.J. Seitz, *Religious Experience and Emotion: Evidence for Distinctive Cognitive Neural Patterns*, “The International Journal for the Psychology of Religion” 2005, No.15/4, p. 263–282; A.B. Newberg, J. Iverson, *The Neural Basis of the Complex Mental Task of Meditation: Neurotransmitter and Neurochemical Considerations*, “Medical Hypotheses” 2003, No. 61/2, 282–291; A.B. Newberg, B. Lee, *The Neuroscientific Study of Religious and Spiritual Phenomenon: Or why God doesn't use Biostatistics*, “Zygon” 2005, No. 40, p. 469–489..

⁵ R.P. Sloan, *Blind Faith: The Unholy Alliance of Religion and Medicine*, New York 2006.

Assume Nothing!

In fact, that very desire forms the first component of the “best practices” which we recommend: *assume nothing*. Within interdisciplinary studies, the effort to coordinate knowledge from different fields in the attempt to address collective questions, in our opinion, must be entered into in the same spirit as any healthy relationship. It is quite easy to assume possession of a greater knowledge than is warranted of the other disciplines. The benefit of true IS, however, is that it does not demand mastery of multiple fields. Instead, the emphasis is on building relationships where the various participants bring their own discrete skills to the project, enabling an examination of the research questions at a variety of levels. An excellent example of how this can be developed is presented by the anthropologist, Gerhard Medicus⁶, who outlines the various levels of analysis and types of questions appropriate within disciplines. Baepler (in press), within communications studies, also explores principles associated with IS more directly in relation to the topic of prayer. From a more mystical perspective, Leonard Swidler and colleagues⁷ outline a seven-stage process that encourages participants to probe collaborations deeply rather than simply address surface level similarities and interests.

There is no real substitute for the willingness to speak and listen; to teach and to be taught. In essence, authentic IS represents a pinnacle in the practice of scientific humility. This is no simple task, for so many novel variables and experiences are brought to the table in IS that their presence is not always immediately apparent. For instance, in our own research group, we bring our experiences with Baptist, Episcopalian, Roman Catholic, Presbyterian (PCUSA), and United Methodist Christian traditions as well as Buddhist, Jewish, Native American, Atheist, and Agnostic perspectives. We differ widely in our level of activity in local congregations. Together, our formal training spans the fields of clinical psychology, dance, experimental psychology, music, social psychology, liturgy, and theology. The range of knowledge and experience certainly presents challenges for clear communication, but it presents an even greater opportunity for creative exploration.

Within this IS context, definitions are of critical importance because while concepts may appear to be similar, frequently the language employed is discipline unique. In addition, even when the actual words match, the underlying assumptions may be different in distinct fields. What constitutes “prayer” for a theologian is different than for a neurologist or a psychologist. Successful IS centers partially on the ability of the participants to develop a common research lexicon by which they will proceed. This does not mean that the concepts must be rigidly inflexible, but it does mean that the scholars involved need to agree upon starting points for these generative discussions.

⁶ G. Medicus, *Fragen zur Geschlechterdifferenz – eine verhaltensbiologische Annäherung*, “Wiener Medizinische Wochenschrift” 2000, No. 150/10, p. 217–224; G. Medicus, *Orientierungsrahmen für Interdisziplinarität in den Humanwissenschaften*, “Wiener Medizinische Wochenschrift” 2003, No. 153/7–8, p. 183–185.

⁷ L. Swidler, R. Firestone, K. Duran, *Triologue: Jews, Christians, and Muslims in Dialogue*, New London CT 2007.

Since the emphasis of our work is not on developing neuroimaging tools, but rather how to use extant imaging techniques to understand the practice of prayer, the definition of prayer takes center stage in the present work.

Why Bother with Prayer?

In recent years, several different research programs working to operationalize prayer as a multidimensional construct⁸ have identified the basic reasons for the importance of examining prayer in an academic context. Perhaps the central reason for investigators to occupy their time with such work is that prayer is a, if not the, core facet of long-established religious traditions. Even those who reject all religious precepts rarely, if ever, dispute this fact.

By and large, however, the accompanying rationales for the study of prayer by these research groups are culturally bounded in two senses: nation and tradition. Baesler⁹ very explicitly links his work on prayer as communication into a U.S. Christian framework, providing a good example of depth of theorizing within a specific national tradition. The primary components of this approach may or may not transfer well to other Christian contexts around the globe. The possible cross-national synchrony is increased by the wealth of communication literature from which Baesler works.

Janssen's research¹⁰ pulls samples from what his research group defines as the secular society of the Netherlands, looking at prayer as a deity-oriented religious ritual consisting of need, action, and effect occurring in a specifiable direction, time, and space. This evaluation of the function of prayer works in harmony with the ideas of prayer as communication and connectivity.

Ladd's approach¹¹, while based on U.S. Christian samples, intentionally includes stimuli that are relatively tradition free and may or may not be applicable beyond Christianity. A strength of this strand of work is the adoption of an inward, outward, upward connectivity model that is common to the spirit of many religious traditions as well as spanning a variety of variations of meditative practices that are not explicitly religious in orientation, but are also not explicitly anti-religious (i.e. an "areligious" standpoint).

⁸ E.J. Baesler, *Theoretical Explorations and Empirical Investigations of Communication and Prayer*, Lewistown N.Y. 2003; J. Janssen, S. Bänziger, *Praying as a Universalizing Variable*, "Archive for the Psychology of Religion" 2003, No. 25, p. 100–112; B. Spilka, K.L. Ladd, *The Psychology of Prayer: A scientific approach*, New York 2013.

⁹ E.J. Baesler, *Theoretical explorations...*

¹⁰ J. Janssen, J. de Hart, C. den Draak, *A Content Analysis of the Praying Practices of Dutch Youth*, "Journal for the Scientific Study of Religion" 1990, No. 29, p. 99–107; J. Janssen, M.H. Prins, J. van der Lans, C. Baerveldt, *The Structure and Variety of Prayer: An Empirical Study of Dutch Youth*, "Journal of Empirical Theology" 2000, No. 13, p. 29–54; J. Janssen, S. Bänziger, *Praying as a Universalizing Variable*, "Archive for the Psychology of Religion" 2003, No. 25, 100–112.

¹¹ K.L. Ladd, B. Spilka, *Inward, Outward, Upward: Cognitive Aspects of Prayer*, "Journal for the Scientific Study of Religion" 2002, No. 41/3, 475–484; K.L. Ladd, B. Spilka, *Inward, Outward, Upward Prayer: Scale Reliability and Validation*, "Journal for the Scientific Study of Religion" 2006, No. 45/2.

A particularly compelling feature of these three independent research programs is that they arrive at highly compatible conclusions: a relatively small number of approaches to prayer suffice to explain a good degree of prayer behaviors. Thus, the importance of prayer receives affirmation from empirical and theoretical sources that are at least somewhat divergent.

What Happened to Religion?

Most recent works broaching the topic of prayer commence by noting that prayer is a core component of religion (which for our purposes here we equate with spirituality¹²). The majority of these claims are traceable to the seminal work of Heiler (1932), who devotes much of his text to the quoting of even earlier sources who affirm the same sentiment. While these quotations of quotations bring a great scholarly weight and unquestionable validity to the discussion, they frequently employ an unfortunate circularity of reasoning: prayer is the core of true religion that is reflected in honest prayer. Missing are succinct definitions of both religion and prayer. The most systematic contemporary approaches to prayer¹³ work to pinpoint prayer as either a special form of communication, a motivated behavior, or a process of connectivity, but in doing so, they, too, have sidestepped the even more fundamental definition of religion. For if prayer is present within most forms of well-established religion, what then, we must ask, is “religion?”

A Conceptual Analysis of Religion and Prayer

Myriad formal attempts at the definition of “religion” have plagued the academic community for multiple generations. Some even have declared the task of defining religion to be so complex as to be insurmountable. In a useful rapprochement in the face of this longstanding turmoil, Modée¹⁴ outlines a conceptual analysis of religion that will lead us toward one possible understanding of prayer. By searching for an *academic concept* of religion (and by extension, prayer), theologies, intuitions, and folk theories are all relegated to secondary status because such biased explanations may or may not correspond to a usefully inclusive scientific definition. Religion, in this case, therefore is not defined by virtue of its social function or its collection of intangible beliefs. Rather, religion is understood in terms of its existence as a type of cultural

¹² K.L. Ladd, M.L. Ladd, *Religion / Spirituality: Differences in Substance or Style?*, “Revista Pistis & Praxis: Teologia e Pastoral” (in press); K.L. Ladd, B. Spilka, *The Psychology of Prayer: A Review of the Empirical Literature* [in:] K.I. Pargament, J. Exline, J. Jones, *APA Handbook of Psychology, Religion, and Spirituality*, vol. 1, Washington DC (in press).

¹³ Cf., Baesler; Janssen; Ladd.

¹⁴ J. Modée, *Artifacts and Supraphysical Worlds: A Conceptual Analysis of Religion*, Lund 2005.

object that has enduring, although neither immutable nor indefinite, character¹⁵. The “religion” *per se* can remain in perpetuity, even in the absence of active practitioners, because it leaves behind archeological evidence (artifacts). Using that evidentiary basis, subsequent generations can re-constitute the social functions and beliefs of any particular version (token) of the cultural object (type) collectively referred to as religion. In Modée’s approach, “X is a religion if and only if X is a collection of artifacts which has the proper function of representing a supraphysical world”¹⁶.

In the attempt to represent the supraphysical world, artifacts adhere to prescribed standards. They must be explicitly made by an agent for the purpose of functioning in a specific social context. Within these strictures, not all are equally capable of telling about or showing directly conceptualizations of the supraphysical world. Some artifacts (e.g., art, language) function as “core props” that offer more direct access to notions of the supraphysical. Other auxiliary artifacts (e.g., clothing, symbols, music, ritual dance) must be interpreted by reference back to core prop artifacts that are thereby intensified by the presence of the auxiliary artifacts.

Among the artifacts known as core props, language stands apart as uniquely able to provide descriptions of the supraphysical world. While storytelling and textual components perform this role admirably, from our perspective they fall somewhat short because they are still relegated to “telling about” the supraphysical. Prayer, however, moves beyond this reflective state, serving as an artifact through which people perceive themselves to actually connect with the supraphysical world in a form of communication. What follows is an attempt to integrate Modée’s theory and the state of the art conceptualizations of prayer found in the works of Baesler, Janssen, and Ladd.

Coordinating Conceptions of Prayer

The core prop artifact of prayer typically has its roots in a complex context situated within a specific temporal reality incorporating social (individual or corporate), environmental (religious or neutral “space”), affective state, physiological, and spiritual (initiating / active or receptive attitude) aspects, all of which are intertwined. Additionally, while the intent of the agent creating the prayer may be irrelevant for subsequent recipients, variables such as the sex of the agent may act as their own discrete contexts that influence overall sensitivity toward / familiarity with various contexts, thereby mediating the effect of the other variables and influencing the final artifact produced. In other words, prayers do not occur in isolation, but rather are embedded in rituals that contextualize them¹⁷.

¹⁵ R.T. McCutcheon, *Manufacturing Religion: The Discourse on sui generis Religion and the Politics of Nostalgia*, New York 2003.

¹⁶ J. Modée, *Artifacts...*, p. 61.

¹⁷ K.L. Ladd, B. Spilka, *Psychological Facets of Ritual: Forms, Functions, and Practice* [in:] R.F. Paloutzian, C. Park, *Handbook of the Psychology of Religion and Spirituality*, 2nd edition, New York (in press).

The combination of these factors will yield a motivational direction that will guide the content of the prayer artifact. The motivation may include a variety of internal concerns, such that it indicates a desire to understand the self more fully in order to connect more closely to others. Alternatively, the compelling motivation may revolve around embracing the paradoxical facets of existence. Or the motivation may center upon a desire to boldly affirm one's own preferences concerning the ordering of the physical world.

Within these motivations identifiable preferred directionalities of connectivity are discernable¹⁸. Inward orientations of self-examination and tearful evaluation of introspection are one possible direction. Outward connections with others in terms of intercession, entering into another person's suffering, petitioning on behalf of someone else, and radically asserting one's own will constitute a second direction. Upward connectivity consisting of a search for rest and engaging traditions provide a third direction.

Core prop prayer artifacts commonly will engage divergent methodologies, including pre-designated and spontaneous uses of auxiliary artifacts (e.g., bells, clothing, incense, bodily positions), to achieve the desired effect of representing the supraphysical world. Whether certain auxiliary artifacts co-occur with either specific motivations or directional content of core prop prayer artifacts is an empirical question not yet addressed. It is plausible, for instance, that internal concerns motivations or inward directional content may link with more subdued auxiliary artifacts while bold affirmations might employ more flamboyant auxiliary artifacts. Additionally, core prop prayer artifacts embracing existential paradox might well be found to stand in relation to more complex as opposed to more simplistic auxiliary artifacts.

It further may be argued within the confines of the above conceptual analysis that while the linguistic form of the prayer is undeniably tangible and hence agent-made the content could conceivably originate beyond the agent-maker of the artifact in question. In this context, we also note that prayer is unique among core prop artifacts because the process is frequently conceptualized as bi-directional or reciprocal in nature. These ideas of reciprocity admittedly occur within the context of various theologies, intuitions, and folk theories that Modée's theory shuns, but the persistence of the formulations across historical record may signal that prayer constitutes a special case of core prop artifact with respect to its origins if not its tangible representation.

In summary, prayer can be represented as a core prop artifact, agent-made in its tangible linguistic form (even if not its origin) and context specific, that is part of a collection of artifacts seeking to represent the supraphysical world on behalf of a religion functioning as a cultural concept. As demonstrated above, this position can incorporate notions of prayer as communication, connectivity, and motivation as outlined in contemporary studies of prayer. What this definition admittedly lacks is the emotionality so readily apparent in, for instance, the Heiler quotations. It is precisely in its dispassionate character, however, that it may prove most usual as an objective starting point for empirical investigations that seek to explore how people respond with "hot" cognitions to "cold" artifacts.

¹⁸ K.L. Ladd, B. Spilka, *Inward, Outward, Upward: Cognitive Aspects...*; K.L. Ladd, B. Spilka, *Inward, Outward, Upward Prayer: Scale Reliability...*

What then of Neuroimaging? A Cautionary Note:

The obvious irony is that humans, and we include most scientists in that group, can become enchanted with technology to the point that the tools employed are so awe inspiring that they overshadow the fundamental nature of the questions most critical and valuable to pose. So we must constantly remind ourselves that technology is no substitute for clear definitions of terms and hypotheses whenever possible. This is in alignment with Richard Sloan¹⁹, one of the few vocal critics of this brave new world combining the study of prayer and technology. He cogently argues that it is of little interest to simply see which areas of the brain increase or decrease activation levels while participants pray, without explicit theory-driven protocols because the probabilities of activation are far too great. It is, relatively speaking, easy to obtain data that are virtually impossible to interpret. Retrofitting theory to data is not optimal; neither is complexity its own reward as Wallace discovers repeatedly when his overwrought machines fail.

Our Place in Neuroscience

The obvious next question is how to integrate the above with a feasible program of neuroimaging. In keeping with our desire to be explicit in our definitions, we will first be clear about our vantage point from within neuroscience, then move on to a consideration of actual imaging procedures. By selecting the phenomenon of prayer as our topic of inquiry, we place ourselves in an area referred to as social cognitive neuroscience (SCN)²⁰. In this realm of investigation lie highly intriguing questions concerning how people: think other people think (e.g., theory of mind); develop personal awareness; demonstrate behavioral flexibility; sustain goal-directed actions; experience depression; and feel empathy along with many other topics related to higher order cognitive processes.

The typical tools at the disposal of SCN investigators are common among other neuroscientists: functional magnetic resonance imaging (fMRI), positron emission tomography (PET), and measurement of event-related potentials (ERP)²¹. From among these, the fMRI is arguably the most informative and will be the focus of this paper.

¹⁹ R.P. Sloan, *Blind Faith...*

²⁰ N.J. Emery, A. Easton, *Introduction: What is Social Cognitive Neuroscience (SCN)?* [in:] *The Cognitive Neuroscience of Social Behavior*, A. Easton, N.J. Emery (eds.), New York 2005.

²¹ For a Review of these and Other Techniques See: A.B. Newburg, B. Lee, *The Neuroscientific Study of Religious and Spiritual Phenomenon: Or why God doesn't use Biostatistics*, "Zygon" 2005, No. 40, p. 469–489.

Pragmatic Challenges to Neuroimaging Protocols

While fMRI may be the current technology of choice, it presents multiple challenges²². For instance, this approach is frequently employed among infra-human populations in conjunction with ablation, lesioning, and other highly invasive techniques not practiced with human populations. The result is that the information concerning infra-humans is considerably more advanced at the present time than is the information with respect to specific human brain function. While cross-species comparability can help in some contexts of cognition (e.g., expectations, planning), those approaches are not available to aid in the investigation of complex prayer behaviors.

Another concern is the high level of noise produced by the scanner during the procedure. Although individuals may acclimate to the sound level, the extent to which this interferes with realistic prayer behavior is unknown. Likewise often associated with the data collection procedure is the utilization of a block design. In this approach, participants engage the stimulus for a brief period of time (e.g., 30 seconds), then disengage for a similar length of time. They repeat this engage / disengage process over a period of several minutes, taking averages of activation states across the time period. It remains unclear as to whether or not people truly experience this on / off approach as a full-bodied prayerful state. The more recent advent of event-related designs partially address this concern, but the extent to which the in-scanner prayer is generalizable to real world praying seems to be quite limited²³.

Also remaining in the realm of the currently unknown but empirically testable, is the influence of the physical position associated with fMRI processes. Does the quality of the prayer experience change as a result of lying motionless on one's back in a confined space? If so, what is the magnitude of the effect and can people reliably acclimate to this condition? Are there difference between this position and other more classic physical posture assumed during prayer (e.g., kneeling or sitting)? Work is now underway in the author's lab to test some of these very questions in an attempt to provide a foundation for subsequent investigations.

Theoretical Challenges to Neuroimaging Protocols

While the above challenges are in the realm of pragmatics associated with procedure, content questions loom as well. Among the most critical centers on how to determine what are proper prayer stimuli to employ. To date, most relevant studies have utilized inconsistent, widely divergent, theoretically unsubstantiated stimuli. Some employ what appear on the surface to be reasonable enough stimuli, such as the clas-

²² J.T. Cacioppo, G.G. Berntson, T.S. Lorig, C. Norris, E. Rickett, H. Nusbaum, *Just because you're imaging the brain doesn't mean you can stop using your head: A primer and set of first principles*, "Journal of Personality and Social Psychology" 2003, No. 85/4, p. 650–661.

²³ K.L. Ladd, C.A. Cook, K.M. Foreman, E.A. Ritter, S.C. Mertes, *Prayer and neuroimaging: Questions of validity. Presentation at the Psychology of Religion and Spirituality pre-conference meeting of the Society for Personality and Social Psychology*, January 2010, Las Vegas NV.

sic 23rd Psalm (“The Lord is my shepherd...”) in comparison to a nursery rhyme²⁴. Although the authors did not specify which children’s poetry they employed, their declaration of a psalm text as the equivalent of a prayer is highly questionable. Even if one accepts the equivalency of psalm and prayer, the psalm is so widely divergent in its imagery that any results could easily be interpreted as related to differences in stimuli breadth instead of the religious or non-religious nature of the content. These facts render findings ambiguous and any interpretations highly suspect; activation and deactivation patterns may be detected, but to what extent do they have anything whatsoever to do with prayer?

In the absence of theoretically meaningful stimulus selection, we must agree with Sloan²⁵ that the prospects for legitimate knowledge advancement are meager. The above outline of prayer as an artifact incorporates the work of three independent labs²⁶ all of which have put forth varieties of theoretically grounded instruments that can prove useful in guiding stimulus selection.

Another concern centers on stimulus presentation. While a large number of SCN studies rely on visual presentations, the choice between visual and auditory stimuli for studies of prayer remains uninvestigated. Prayers are frequently encountered in both formats and it is unknown which mode will work most effectively in conjunction with either block or event-related designs. The above theory of prayer as a core artifact suggests the inherent power of a linguistic presentation, but does not differentiate between the ability of the artifact to effectively represent the supraphysical world in a printed versus a spoken context. If auditory stimulation is optimal for induction of a prayerful experience, is there a “best” sound to the voice? The availability of specialized voice reproduction software greatly simplifies the amount of effort required to answer this question effectively.

A related question centers on the relation between theology and technology. While the above sketched prayer-as-artifact theory explicitly removes theology as a definitional factor, this is because the theory casts an exceptionally wide net. There must, however, be theory development that moves the discipline deep within the context of particular traditions both Western and Eastern. This is in recognition that, for most people (i.e., not scientists), prayer is fundamentally a theological declaration concerning a desire to connect with a reality that is beyond oneself²⁷. The extent to which theological and technological studies can be effectively integrated within theoretical boundaries remains an open question²⁸.

On a positive note, while many SCN studies face the challenge of creating realistic social interactions while participants are confined to a scanner, prayer investiga-

²⁴ N.P. Azari, J. Missimer, R.J. Seitz, *Religious Experience and Emotion...*

²⁵ R.P. Sloan, *Blind Faith...*

²⁶ E.J. Baesler, *Theoretical Explorations...*; J. Janssen, J. de Hart, C. den Draak, *A Content Analysis of the Praying Practices of...*; K.L. Ladd, B. Spilka, *Inward, Outward, Upward: Cognitive Aspects of Prayer*; K.L. Ladd, B. Spilka, *Inward, Outward, Upward Prayer: Scale Reliability and Validation...*

²⁷ T.N. Hanh, *The Energy of Prayer: How to Deepen your Spiritual Practice*, Berkley, CA 2006; K.L. Ladd, B. Spilka, *Inward, Outward, Upward Prayer: Scale Reliability...*

²⁸ F. Watts (ed.), *Perspectives on Prayer*, London 2001; *Idem, Theology and Psychology*, Burlington, VT 2002.

tions are not so constrained since in the minimal condition they require the physical presence of only a single person!

Summary of Specific Challenges

Our considerations above should not be construed as “deal breakers” for the study of prayer using neuroimaging techniques. Instead, they should be taken for what they represent: reminders of the standard best practices associated with the careful conduct of scientific inquiry. We would not launch an investigation of a new drug without carefully operationalizing both the drug and the outcome variables. We would want to know if there was any dose response or potentially adverse outcome issues associated with intravenous versus oral (liquid, tablet, capsule) administrations. We would be concerned about all the classic issues pertaining to the various forms of reliability and validity. We would thoroughly evaluate the experimental and mundane realism of the procedures. In short, we would be more like a scrupulous scientist than a dramatic boxing promoter; both display highly effective traits in pursuit of radically different goals, with the former arguing for empirically precise evaluations as the basis for scientific advancement and the latter thriving on hyperbole to attract and excite audiences.

Wider Considerations for Social Cognitive Neuroscience Protocols

Emery and Easton²⁹ summarize and address 10 questions originally presented by Adolphs³⁰, who suggested these issues as guides for SCN field development. Most of these questions are applicable to the study of prayer using neuroimaging techniques and we briefly address them in turn below.

1. How can we measure social behavior?

As mentioned above, this is somewhat of a plus for prayer related SCN studies since typically only a single person is required to engage in prayer. What is more difficult, if not impossible, is to determine how best to compensate for the fact that prayer frequently occurs in the context of social gatherings, replete with movement, symbolism, and other contextualizing features. In addition, the theology underlying prayer often makes explicit the idea that the person engaging in the prayer does so in the mystical company of other believers, past, present, and future. Even if fMRI technol-

²⁹ N.J. Emery, A. Easton, *Introduction: What is Social Cognitive Neuroscience (SCN)?* [in:] *The Cognitive Neuroscience of Social Behavior*, A. Easton, N.J. Emery (eds.), New York 2005.

³⁰ R. Adolphs, *Investigating the Cognitive Neuroscience of Social Behavior*, “Neuropsychologia” 2003, No. 41, p. 119–126.

ogy no longer required confined, stationary positioning, the list of potential correlates would be daunting. Recent work suggests that prayer is experienced in radically different ways when inside an imaging machine³¹ and this has ramifications for how the work can develop.

2. How should social stimuli be categorized?

The identified use of physical properties or *a priori* categories can both work in conjunction with prayer studies. If using individual words as prayer stimuli, characteristics such as phonemes could be monitored for effect. Categories of prayer content systematically derived from multiple samples already exist³²; what remains to be seen is the extent to which these categorizations withstand translations across traditions and cultures³³.

3. How can we best use data to guide theory?

Some scientists contend that if one needs to appeal to statistics to substantiate one's findings, then the experiment was not adequately designed³⁴. At the very least, Cobb's³⁵ observation that simple statistics undergird many Nobel prizes, reminds us that the role of data is to address clearly articulated hypotheses, which in turn speak to the viability of a theoretical framework. The current movement, as noted by Emery and Easton³⁶, toward reporting effect sizes and confidence intervals will make findings more transparent and less susceptible to interpretive biases, but these measures are no substitute for detailed operationalizations of variables coupled with experimental designs wherever possible. This is particularly true in the area of prayer where the multidimensional nature of the practice is frequently overlooked.

³¹ K.L. Ladd, C.A. Cook, K.M. Foreman, E.A. Ritter, S.C. Mertes, *Prayer and Neuroimaging...*

³² J. Janssen, J. de Hart, C. den Draak, *A Content Analysis of the Praying Practices...*; K.L. Ladd, B. Spilka, *Inward, Outward, Upward: Cognitive Aspects...*; K.L. Ladd, B. Spilka, *Inward, Outward, Upward Prayer: Scale Reliability...*

³³ K.L. Ladd, N.C. Hvidt, D.T. Viftrup, A.E. Asakitkpi, P. Kapur, M.R.G. Esperandio, A. Lazar, M.L. Ladd, *A Seven Nation Exploration of Prayer Content. Presentation at the Meeting of the International Association for the Psychology of Religion*, August 2011, Bari, Italy; K.L. Ladd, *Conceptualizing "prayer" for an East – West Dialogue and Beyond. Keynote Address Presented at the Conference, The Psychology of Religion and China and the US: Methods, Topics, and Collaborative Opportunities*, July 2012, Beijing, China.

³⁴ "If your experiment needs statistics, you ought to have done a better experiment". Widely attributed to the physicist Ernest Rutherford.

³⁵ L. Cobb, *Top-down Research Design*, www.aetheling.com/docs/TopDown.htm [accessed: 13.12.2012].

³⁶ N.J. Emery, A. Easton, *Introduction: What is Social Cognitive Neuroscience (SCN)...*

4. What is the most appropriate way to interpret the data?

In this realm, it will be critical for investigators to maintain awareness that statistically significant results that favor, disconfirm, or are mute in relation to stated hypotheses may very well mean relatively little with respect to theological interpretations within specific traditions. The business of science is not to test truth claims, but to evaluate tangible effects. Research concerning prayer, especially intercessory prayer, can easily slide toward apologetic interpretation. This is equally true for scholars who personally adhere to some faith system and for those who do not; biases run in many directions. Thinking of prayer in particular, researchers must work first to understand the context in which the participants are practicing this exercise. In other words, the underpinning theology must be understood and recognized on its own merits because it is out of this milieu that the behavior arises.

5. How can we best establish the reliability and generalizability of our results?

As in many other aspects of the sciences, replication across a variety of samples drawn from diverse populations will be key to answering this question. Careful attention will need to be given to definitions of diversity. For instance, while traditional denominational labels are readily accessible, there are a number of more theoretically meaningful ways to evaluate underlying religious and spiritual characteristics³⁷. In addition, work on the topic of prayer must expand beyond largely Christian contexts. Other traditions, both old and new, also practice prayer and without exploring these faith positions, it is not possible to fully understand Christian prayer. It will also be interesting to watch as work on atheism moves forward because it is very likely that practices similar to prayer (without a specific divine referent) exist even within that orientation. We must also monitor the measures we employ to avoid redundancy among them. For instance, asking “Do you feel peaceful during prayer?” will display a strong relation to questions such as “To what extent are you a peaceful person?” The former could easily appear in a “prayer” scale and the latter in a “life satisfaction” scale. The relation, while mathematically powerful, means very little because of the semantic overlap. This sort of conceptual and linguistic overlap can be observed readily in the field; this must be rectified.

6. How theoretical should SCN be?

There are copious amounts of data available with respect to many of the complex cognitive and affective facets of prayer. Work on memory, perception, planning, anticipation, moods, and so forth are all relevant. Continual attempts to link these divergent areas will offer constantly refined theories of interaction among brain structures. Coupling these with advances in non-physiological theorizing about prayer

³⁷ P.C. Hill, R.W. Hood (eds.) *Measures of Religiosity*, Atlanta GA 1999.

will require the establishment and maintenance of interdisciplinary teams of scholars conversant across multiple specializations. At present, there is very little room to move, except upward since theory is relatively sparse concerning the psychology of prayer³⁸. This is not due to a lack of possibilities for theorizing, but more likely related to the stage at which the field exists. As more scholars enter the area, they will bring with them a host of tools and theories that will begin to influence thinking. Is it possible that we could ever have too much theory? To the extent that the theories available generate complimentary or contradictory predictions, the answer is clearly “no”.

7. What should be the language of SCN?

While the fundamental question stresses a choice between social psychology and cognitive neuroscience, the study of prayer incorporates the additional languages of philosophy, religious studies, and theology. Each has its own unique vocabulary and mannerisms associated with phrasing and answering questions. A solution involving a single acceptable lexicon is unlikely; the next best approach will be scholars who are willing to spend additional time and effort to acquire at least minimal cross-training to further the dialogue and active exchange of ideas. Such an investment of time, however, is in some ways antithetical to the academic tradition. Most scholars earn their compensation by virtue of teaching and publishing. To the extent that faculty positions become rare, they become highly competitive. As competition increases, it becomes more and more difficult to spend time immersing oneself in a novel area of study, especially if there is no immediately apparent benefit. In very practical terms, then, if one desires to grapple with prayer in the SCN tradition, the languages of neuroscience and of theology will be the minimal requirements. With only one or the other, the risk of biases radically increases. With both in operation, a certain level of balance is achieved, rendering the work and its interpretation more likely to be meaningful.

8. Are social processes reducible to nonsocial processes?

Reductionism has long been a point of contention between religionists and scientists. As in the above contexts, it will be critical to remember that the former concerns itself with truth claims, while the latter considers more mundane issues of probabilistic occurrences. Exploring the topic of prayer brings this juxtaposition into strong relief. Since, as noted above, prayer is fundamentally a statement about supraphysical beliefs, researchers have a fine line to tread upon. To what extent can we speak of prayer as a coping mechanism or as a meaning-making tool before we lose sight of why people say they engage in the practice? This inherent supraphysical aspect means that reductionism is not an acceptable option. Why not? It is because prayers, especially with regard to questions of efficacy, exist simultaneously in both the physical and the supraphysical realm. Focusing on only physical features of prayer practice discounts

³⁸ B. Spilka, K.L. Ladd, *The Psychology of Prayer...*

its supraphysical claims; focusing only on the supraphysical portions sacrifices scientific methods and generalizable findings.

9. How will we be able to understand a future SCN?

Will neuroimaging studies of prayer behavior alter the way that people engage in praying? Perhaps. It is likely that some people will adopt or discontinue prayer activity on the basis of findings in this field. It is equally likely that the vast majority of people will make their decisions concerning prayer predicated on facts (broadly defined) collected from a variety of sources. What we can hope for is that the state of neuroimaging will continue to be refined and provide information that effectively maps onto real world practices. At present, this is not necessarily the case. People rarely explore their prayer lives on a regular basis while lying on their back, wearing an immodest hospital gown that is not capable of dispelling the necessary chill of the room, all while inside a very noisy 60 cm tube. With the advent of open imaging machines that feature better noise attenuation, the realism is ever-so-slightly improving.

At the same time, the mapping of the brain becomes more precise each day. This ability to measure more and more specific changes in activation is providing better data upon which to make decisions. Those interpretations, however, remain another area for improvement. Currently, there is no consensus on the nature of the relation between neural activation and the phenomenological experience of consciousness, let alone the practice of prayer. The leap from the physical to the supraphysical may be somewhere in the future SCN, but only time will reveal that answer.

10. How integrative should SCN be?

With respect to the topic of the current paper, we have already addressed this question at multiple points along the way. In order to undertake such a venture, integration and the ability to think in terms of both breadth and depth are necessary. As such, sweeping integration is inevitable. The question that must be asked, then is: What sort of changes will such integration entail? By definition, integration suggests an outcome that alters the participants. One of the most interesting facets to watch here will be how the science and theology move forward. They are traditionally at opposite ends of the speed spectrum, with science and technology changing overnight while theology tends to move at a more glacial pace. This obviously could create a great deal of frustration, however, it also holds great promise. The promise lies in the fact that as science races ahead, the technology available can outstrip the ability to understand its implications (e.g., cloning, stem cells, etc.). The interaction with theology has the potential to create a more reflective science. As long as this reflection is open to multiple theological traditions, employing the methods of theology alongside scientific pursuits can deepen the contributions of science, especially in areas of real-world applications. In return, SCN can help us better understand how theological positions relate to tangible portions of existence. This knowledge of the embodiment of theology could prove equally exciting.

Conclusion

The purpose of this paper is to provide intellectual fodder to promote the growth of a discussion concerning how best to approach the study of prayer via neuroimaging techniques, especially in the context of SCN. To address that goal, we have offered a sketch of one way to conceptualize prayer in very broad terms that incorporate philosophical, historic, and contemporary issues surrounding definitions of religion in general and prayer in particular. In addition, we have identified several pragmatic and theoretical challenges confronting investigators wishing to use imaging tools to study the neural bases of prayer. Finally, we have offered brief comments on an important set of questions that can serve to inform the SCN field at large, but can simultaneously guide thinking about the more specialized imaging work on prayer.