

Building Bridges through Science

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Science is ideally suited to connect people from different cultures and thereby foster mutual understanding. To promote international life science collaboration, we have launched “The Science Bridge” initiative. Our current project focuses on partnership between Western and Middle Eastern neuroscience communities.

It's a warm summer evening in 900 AD. Atheist, Buddhist, Christian, Jewish, and Muslim scholars sit together and engage in vibrant scientific discourse. They might be talking about optics, the economy, medicine, or mathematics. Discussions become heated but remain civil, as mutual respect is of paramount importance in their host's culture. The country in which they reside prospers economically and is mostly peaceful internally.

None of these scholars has to fear persecution or punishment for speaking their mind, as their arena of discourse is currently the most liberal place on Earth, pioneering freedom of speech, tolerance toward various beliefs and values, and protection of human rights.

It might be surprising to hear that this scene is set in the Arabic Abbasid Caliphate, in what is now Baghdad, Iraq (Figure 1A). A brief glance at the current

news coverage makes it seem as if cultures from the West and the Middle East could not possibly coexist peacefully. Many centuries ago, however, scientific collaboration in this region between people from diverse cultural backgrounds was intense and fruitful. The first recorded efforts to bring together Eastern and Western sciences took place during the “Golden Age” of Arab and Persian cultures (7th to 13th century AD), when Greek,

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Roman, Chinese, Indian, and other texts, written by eminent scholars, were translated into Arabic and then into other languages such as Hebrew and Latin. In a region spanning vast lands from Baghdad in the East to Andalusia in the South of Spain, this period was marked by an unprecedented embrace of liberalism, religious freedom, skepticism, and freedom of speech. One quote from a letter by the astronomer Al-Hashimi (ca. 890 AD) exemplifies this:

Now that you are safe and free to say whatever you please, appoint some arbitrator who will impartially judge between us and lean only towards the truth and be free from the empery of passion, and that arbitrator shall be Reason, whereby God makes us responsible for our own rewards and punishments. Herein I have dealt justly with you and have given you full security and am ready to accept whatever

decision Reason may give for me or against me (Arnold, 1913).

Back then, the Arab world attracted some of the brightest minds of different cultures and religions from around the globe and promoted cross-cultural dialog and innovation. Not by coincidence, the oldest university in the world today was established in Morocco during this period (the University of Al Karaouine in Fez, founded in 859 AD), and the foundations for the modern public library system for the dissemination of knowledge were laid. During this era, Arab, Jewish, and Persian scientists made important advances in scientific methodology, including the emphasis on real-life experimentation over pure thought by Ibn Al-Haytham (Alhazen, 965–1040 AD) in physics (Bala and Duara, 2016) and Al-Razi (Rhazes, 854–925 AD) in medicine (Abdel-Halim, 2011), as well as the introduction of medical case-control studies by Rhazes and Ibn-Sina (Avicenna,

980–1037 AD) (Abdel-Halim, 2011; Bala and Duara, 2016) and preventive medicine by Rabbi Moses ben Maimon (Maimonides, ca. 1135–1204) (Rosner, 1996). *The Canon of Medicine* by Avicenna was translated into Latin, distributed throughout Europe, and became the reference medical book in the Western world from the 12th to the 17th century.

Significant contributions were also made in mathematics. Muhammed Al-Khwarizmi (ca. 780–850), a Persian mathematician, popularized the Indian numerical system (1–9 and 0) (Crossley and Henry, 1990) and thereby profoundly advanced the use of mathematics in all fields of science. He is credited for the concepts of “Algebra” and “Algorithm” (Crossley and Henry, 1990), both of which are essential in modern times for calculations, data processing, and automated reasoning tasks. Without these innovations, computer programming, electrical circuit design, and accurate description

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of neural networks would not be feasible. The comprehension of mathematics in the Middle East and Persia led artists to display various kinds of symmetry on surfaces. The girih-tile decoration in mosques from the 15th century (Figure 1B) is an awe-inspiring example at the interface of mathematics and art, which anticipated principles of quasicrystalline geometry (Lu and Steinhardt, 2007) and points to a profound appreciation of general mathematical ordering principles in nature. The Swedish Academy, which in 2011 awarded Dan Shechtman the Nobel Prize in Chemistry for his discovery of quasicrystals, noted in their press release:

Aperiodic mosaics, such as those found in the medieval Islamic mosaics of the Alhambra Palace in Spain and the Darb-i-Imam Shrine in Iran, have helped scientists understand what quasicrystals look like at the atomic level. In those mosaics, as in quasicrystals, the patterns

are regular—they follow mathematical rules—but they never repeat themselves.

What were the reasons for the flourishing of science during the medieval Golden Age? They are manifold but can be traced back to a great extent to the open attitudes and achievements of the ruling royal house of Abbasid, including the fostering of an open economy based on world-wide trade, unrestricted use of vast knowledge acquired during early territorial expansion, and a government that encouraged free speech. The Abbasids also placed special emphasis on knowledge and scientific pursuit.

Inspired by these examples, we think that science could be a potent mediator in today's times and facilitate peace building and reconciliation. The cornerstones of science are rational thought and reliable evidence as well as a constant willingness to challenge established dogma. This allows scientists to

communicate in a space devoid of factors like fundamentalism or nationalism that block a free exchange of ideas. Also, the results of the scientific endeavor are virtually always beneficial to the society in which it is performed, as evidenced by the enormous success of science and technology in prolonging and enhancing people's lives in industrialized nations.

At the current time, we believe that neuroscience is a discipline optimally suited for reconnecting Western and Middle Eastern nations (including Pakistan, Bangladesh, Iran, Turkey, Afghanistan, and North Africa). After all, the quest to understand the brain touches the very nature of who we are as individuals and as a species. Interest in the brain and in the origins of our mental life has been persistent since the dawn of human societies, from the first surgical records in ancient Egypt (i.e., the Edwin Smith surgical papyrus, 1700 BC), through Greek philosophers such as Alcmaeon of Croton

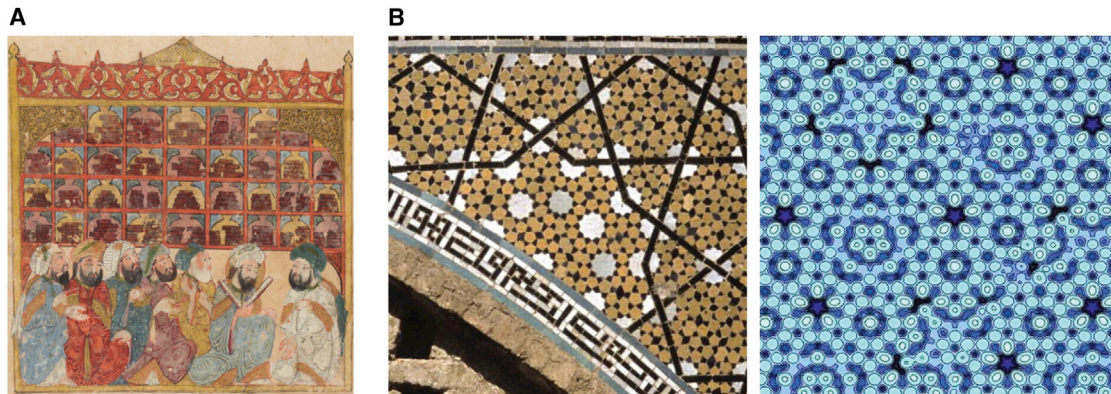


Figure 1. Arabic Golden Age in Science

(A) The Abbasid caliphate fostered a vibrant intellectual culture. Depicted here are intellectuals in front of a library (from the *Maqamat* of al-Hariri, 1237 AD, illustrated by Yahya ibn Mahmud al-Wasiti, original manuscript in the National Library of France).

(B) Arabic and Persian art anticipated principles of quasicrystalline geometry. Left: Girih-tiles, Darb-i Imam shrine, Isfahan, Iran (from Lu and Steinhardt, 2007; reprinted with permission from AAAS). Right: quasicrystals in nature. Calculated potential energy surface for Al adatom on 5-fold i-Al-Cu-Fe (Thiel et al., 2011).

(500 BC), to current modern neuroscience originating in the 18th and 19th centuries with studies by European scientists such as Galvani, Cajal, and Sherrington. Because of the vast complexity of the nervous system, neuroscience is necessarily a highly multidisciplinary endeavor, encompassing physiology, chemistry,

molecular and cellular biology, physics, computational science, and psychology, among others (Figure 2A). Every neuroscientist, regardless of discipline, needs the help and input of those in other fields to fully advance his/her own insights. Hence, neuroscience is uniquely suited to promote open communication be-

tween scientists from different cultural backgrounds and to create a system of collaborative interdependence that is conducive to long-term dialog and the fostering of diversity.

Beyond the intellectual quest to unravel the mysteries of the brain, neuroscience offers particularly relevant practical benefits. Middle Eastern nations are plagued by the same nervous system diseases as in the West, with many being about equally prevalent (i.e., schizophrenia and Alzheimer's disease) while others are even more common (i.e., post-traumatic stress disorder [PTSD] in war zones; Neria et al., 2010). Regional differences in climate, culture, and genetic lineage offer unique opportunities to study environment-gene-phenotype interactions (Figure 2B). Importantly, insights from modern neuroscience (i.e., that many psychiatric conditions have physical correlates in neural circuitry) could have a profound positive impact on patients in the Middle East, where problematic attitudes towards mental health conditions have been reported (Sewilam et al., 2015).

In this regard, we place special importance on neurodevelopmental disorders that will impact future generations but could be prevented today. There is ample evidence that maternal disease, stress, and trauma during pregnancy and childhood, referred to as early life stress, can predispose an individual for many psychiatric conditions, including depression, PTSD, borderline personality disorder,

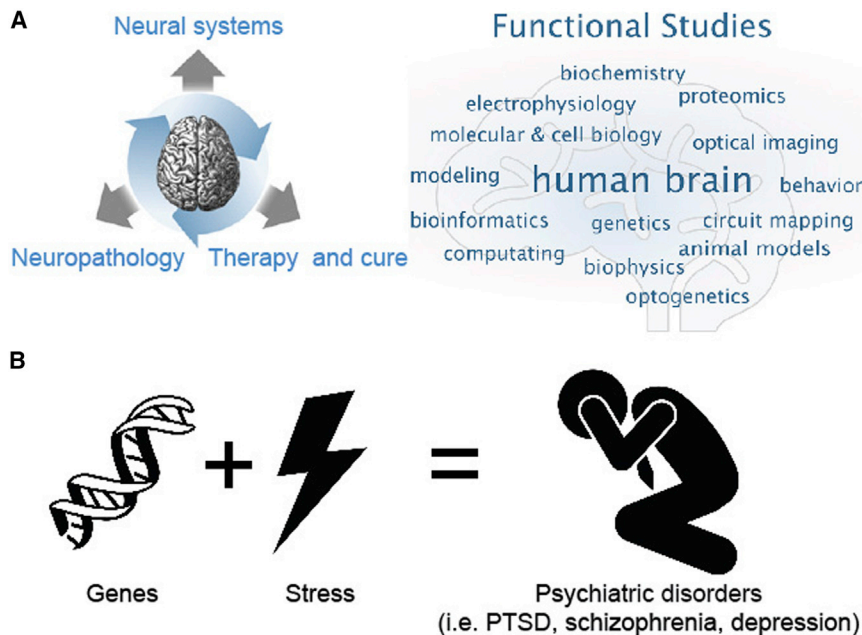


Figure 2. Neuroscience Is an Interdisciplinary Endeavor

(A) Understanding the brain requires a holistic approach encompassing many different disciplines and thus many different individual researchers from various backgrounds.

(B) Translational neuroscience and psychiatry are crucially needed in many Middle Eastern countries. One important factor is the uniqueness of this region with regard to genetic background and extreme environmental conditions.

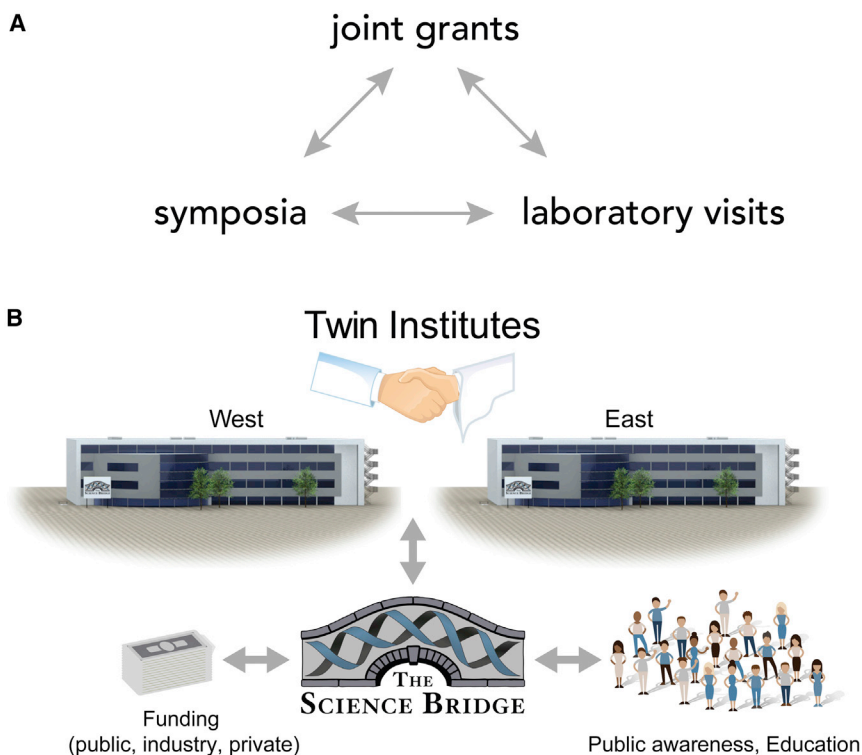


Figure 3. The Science Bridge

(A) Short-term goals: joint grants, symposia, and laboratory visits for mutually beneficial research pursuits and trust building.

(B) Long-term goals: building “Twin Institutes” in the West and the Middle East. With fundraising to materialize our goals, we will engage the public, both Western and Eastern, and chart a course for the well-being of all people. Money (http://www.freepik.com/free-vector/economy-icons_794700.htm) and people (https://www.freepik.com/free-vector/template-with-people-forming-an-arrow_759920.htm) symbols designed by Freepik and modified.

autism, and schizophrenia (Carr et al., 2013). Since there is an abundance of extreme stressors in many Middle Eastern nations today, resulting from war (leading to a heightened and prolonged stress response) and conflict-driven poverty (resulting in malnutrition and poor healthcare), implementing preventions for neurodevelopmental disorders will be of paramount importance for the well-being of future generations. This becomes especially crucial considering the vast influx of refugees from war-torn Middle Eastern countries to European nations and the U.S. There is extensive evidence for an increased prevalence of mental health problems among refugees (Kirmayer et al., 2011), and host nations should have a strong interest, from both humanitarian and economic perspectives, in treating psychiatric disorders to ensure a successful and harmonious communal life.

The development of brain-related theories and practices has a long tradition in the Middle East, as exemplified by the monistic view of mind and body and the importance of a holistic approach in treating psychiatric diseases (i.e., dietary regimens and involvement of the patient’s social circle during therapy). Unlike in other parts of the world, where the mentally ill were ostracized, medieval Middle Eastern Judaism and Islam had a strong intellectual interest in the management of psychiatric disorders (Boehnlein, 2000). As such, these cultures nowadays possess a rich repertoire of customs and practices that promote healing of the mind through the body and vice versa (i.e., meditation practices in Judaism and the Sufi whirling dance in Islamic cultures). Studying these phenomena could give valuable insight and inspiration in areas such as biofeedback, neuroimmunology, and economic population-scale treatment of depression.

In the 7th century, Middle Eastern regions pioneered mental health treatment, for instance, by constructing hospitals called “märistäns.” These buildings were safe and aesthetically pleasing and located in the centers of cities so that relatives could easily visit and facilitate the patient’s recovery through social interactions (Mohit, 2001). Prominent leaders during this time include Al-Razi, Maimonides, and Ibn-Sina, whose transformational contributions paved the way to modern medicine.

The rich history of more liberal attitudes to mental health implies that the current problems regarding psychiatric disorders in some Middle Eastern nations are not due to inherent, inevitable cultural bias but rather circumstantial and dependent on social and economic factors, lower living standards, and perhaps even insufficient communication of scientific knowledge.

To overcome intercultural gaps and to address the challenges outlined above, we have founded The Science Bridge initiative (TSB; <https://www.thesciencebridge.org>). We pursue a strategy that incorporates both short- and long-term goals. In the short term, TSB aims to facilitate collaboration and free movement among existing research institutes by establishing student and researcher exchange programs, sharing collaborative research grants, and organizing scientific symposia among participating labs (Figure 3A). Notably, the recent rise in the construction of new science and technology institutes in Middle Eastern territories is part of a movement to embrace scientific innovation and discovery. These efforts will chart a roadmap for international collaborations. The long-term goal of TSB is the creation of “Twin Institutes,” with one research institute being located in a Western and the other one in a Middle Eastern country (Figure 3B). Scientists in the paired institutes will collaborate intensely through an infrastructure that encourages cross-cultural dialog and will have a dedicated human resource department with expertise in the unique problems that researchers participating in East-West collaborations might face.

We will also place special emphasis on communicating the research results of these studies to the public so that the

transformative nature of science can benefit all people in the participating countries and provide testament to the achievements of the two cultures working hand in hand. Another goal of TSB is to promote talent that is currently dormant in the Middle East. Surely, intelligence and aptitude in science are distributed across a bell curve in every region of the world, and there is thus great untapped potential in the Middle Eastern nations. The Science Bridge initiative aims to create unique opportunities for talented young minds to be trained in research. Because the Middle Eastern cultures nourish their proud heritage and still strongly value science in today's more difficult times, we will support the local training and integration of scientists who were born in Middle Eastern countries, received parts of their education elsewhere, and wish to return to their home. In order to realize these goals of intercultural exchange, TSB depends on the backing of the larger scientific community, and hence, we here make a call for participation in our initiative.

Finally, for mankind to continue on its path toward peace and harmony, we have to keep transforming intercultural dialog and find unshakable common denominators. Two of these are the pursuit of wisdom and ensuring individual health. With a whole variety of sometimes very different values and beliefs in our societies, health and knowledge are the two

things that every single person cherishes and deserves to acquire and maintain. Witnessing the astounding power of science and technology to enhance our lives, we maintain that scientific progress will be absolutely crucial in global peace building. In biology, diversity enables successful adaptation, whether it concerns cells, organisms, or entire populations. By analogy, cultural and geographic diversity should enable us to more efficiently tackle the hardest problems concerning the brain, such as the mystery of consciousness and the devastating impact of psychiatric and neurological disorders. The Science Bridge aims to create a new dimension of collaborative research focused on advancing basic and translational life science. We hope that our initiative will open a new chapter in East-West science exchange and contribute to inter-cultural harmony and scientific advance.

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