AFOSR International White Paper Submission

Instructions: Please complete the requested information in the blocks below. This format will help accelerate the evaluation of your proposed research, and allow other program managers in the Dept. of Defense to more quickly determine if there is funding/co-funding interest. In addition, please attach a 1-2 page technical supplement of the proposed research, including any necessary figures and additional references. If there is potential funding interest, a Program Officer will then suggest you submit a grant application.

Project Title:	PSYCHOTRONIC AND NEUROWEAPON TECHNOLOGY TRANSFER		
Principal Investigator:	Mr. Lucas Whitman Pomeroy		
Institution:	AFOSR/DIA		
Proposed Duration: *(In months)*	156	Approximate Funds Needed ($): *(Please describe in tech supplement)*	3,000,000,000

OBJECTIVE: Briefly describe the overall objective(s) of the proposed research. What do you hope to accomplish?

Freedom, Order and Security: Through development of the transition technologies, strategic analysis, including analysis of current and potential adversaries' scientific, technological, and weapons capabilities, will improve through the integration of all intelligence capabilities to better anticipate, monitor, and convey warning intelligence and policy-related opportunities. Part of this project's objective is to stop the mis-use of these technologies and develop ethical research guidelines for this and other future technologies.

SUMMARY OF APPROACH: Briefly describe how you plan to accomplish the research objectives.

Through a collaborative effort, the anticipated approach will include the responsible development of our technological prowess to anticipate threats and recognize opportunities, while maintaining or developing stability and maximizing individual freedoms. This project will provide the backbone necessary to implement many technologies that are currently black and classified.

The mission of the AFOSR is also part of the objectives and approach of this project. "AFOSR personnel do not dream about what is possible—we accomplish what many believe is impossible. We focus on the science of the future today; enabling a future Air Force that will be far more technologically advanced than any peer." This program will develop and implement a unified contingency response to facilitate rapid transition to support multiple, concurrent military contingency operations. Computer systems have become a mandatory ingredient in exchange, customs and security. Fortifying our computer systems against attack is necessary for economics, exchange and security. The threat in the future to our society from mind-computer interaction will increase, and protocols and measures must be developed to ensure individual freedoms are guaranteed and systems and minds cannot be hacked. We must develop an economic system that accounts for our total resources and is based upon a different system than is currently in place. Our current economic models lack some very important, basic, economic data that I have developed. A classified reference book, in combination with image evidence, has been created and provides the mathematics behind my theories, in detail.

Thus far, the project has provided the values necessary to proceed with further implementation: These technologies are being used to torture humans. Part of this project's approach will be to stop unethical research regarding these technologies and provide the necessary logic and mathematical values to proceed with the objectives of the project.

POTENTIAL IMPACT: Briefly describe why the proposed research is important or how it is novel. What is the expected impact on the state of the art? How do you think it address gaps or opportunities in the current body of knowledge?

It has been shown in classified and non-classified settings that psychotronics and neuroweapons are now a reality that must be addressed. The risk to society due to these technologies is extreme. Our entire society is underpinned by the belief that your own thoughts are, in fact, your own. We now know that this is not always the case. Allowing these technologies to invade that basic requirement for our society to proceed is very dangerous and if allowed, will destroy humanity forever.

Further potential impacts on society from this project include everything from increasing the average lifespan of humans to terraforming Mars for a human presence. This technology and situation has major implications for the future of humankind. It is the hope of Mr. Pomeroy to work within the system and laws to stop this gross torture of humans, move forward to the future and implement this project for our stability and evolution.

QUALIFICATIONS FOR PROPOSED RESEARCH:

Please provide a brief description of the proposer's qualifications, capabilities, related experience, facilities or techniques, or a combination of these factors that are integral to achieving the proposed research objectives.

The purpose of this proposal is to offer services for technology transition protocols, in conjunction with my partners, to the AFOSR. Services will include personal and government security services, among other services that directly support the AFOSR, the military in general, the intelligence community and the Federal Government.

BAD (Buckle & Bernard Agency Developers) is a Top Secret organization developed by Mr. Lucas W. Pomeroy. Its mission is to free the oppressed and assist with ending suffering. BAD gets called when governments need help developing proper "agency." Most previous experience cannot be discussed in an unclassified white paper. See www.menblack.info for more information.

Mr. Pomeroy previously worked for Parsons Corporation, which is a Top Secret Federal Government Contractor, and was involved in high-level technology transitions.

The facilities to be used will be determined at a future date, but the U.S. Federal Government already has SCIFs, along with other National Governments, that are currently being used in association with Mr. Lucas W. Pomeroy.

ATTACHMENT: Please check box to indicate whether technical supplement is attached.

☑ **Technical Supplement (Desired)**
Include short (1 or 2 pages) technical summary of the proposed research. Focus should be on what you are proposing to do, rather than review too much of what has already been done (can be included in references). No particular format is required.

AIR FORCE OFFICE OF SCIENTIFIC RESEARCH

TECHNICAL REPORT

Submitted by
Mr. Lucas W. Pomeroy

October 3, 2014

1. This statement is from the AFOSR white paper form and is instructions on what should be in this Technical Report:

    a. "Focus should be on what you are proposing to do, rather than review too much of what has already been done (can be included in references)."

2. What has been done is so important to this project that answering the above question would degrade the viability of the project, because, quite frankly, the government does not listen. You have to pay to play, Air Force.*

3. What is proposed is discussed satisfactory in the white paper. Technically, the technical aspects are classified and they cannot be discussed in this unclassified white paper.**

4. For the future, Mr. Pomeroy desires classified or proprietary discussions with the government over this project and other issues. Foreign participants or organizations may be involved in this effort. It is anticipated that partnering with others to accomplish the initiative in question will be necessary.

5. Many people are aware of this situation. Meeting and talking with relevant parties will provide further input for the future direction of this effort. It is imperative to receive stakeholders input when implementing a plan that is adaptive to situations, circumstances and changing policies.

6. Mr. Pomeroy has partners that have technology that surpasses anything that humans can or will develop. Technology is a double-edged sword. It can have incredible benefits but could also destroy humans forever. We need help implementing new technologies properly and Mr. Pomeroy and his partners are here to help with that effort.

7. For reference on the unclassified current state of the technologies, the enclosed Proposal to the Department of Homeland Security is provided, which currently has been denied. It has extensive information and other technical reports that support this project's objective and position.

*"You can't wake a person who is pretending to be asleep." - Navajo Proverb
**"Hence it is that which none in the whole army are more intimate relations to be maintained than with spies. None should be more liberally rewarded. In no other business should greater secrecy be preserved." - The Art of War

DEPARTMENT OF HOMELAND SECURITY

UNSOLICITED PROPOSAL

FOR PSYCHOTRONIC AND NEUROWEAPON TECHNOLOGY TRANSFER

CONTACT

MR. LUCAS W. POMEROY

530-219-7595

LWPOMEROY@YAHOO.COM

SEPTEMBER 25, 2015

BASIC INFORMATION INCLUDING:

1. Offeror's name and address and type of organization; e.g., profit, nonprofit, educational, small business;

a. Lucas W. Pomeroy, 528 Hudson Court, Davis, CA 95616: Profit

2. Names and telephone numbers of technical and business personnel to be contacted for evaluation or negotiation purposes;

a. Lucas W. Pomeroy: 530-219-7595

3. Identification of proprietary data to be used only for evaluation purposes;

a. Psychotronics and Neuroweapons

1. Technology Protocol Techniques: For the protection from psychotronics and neuroweapon attack on humans.

2. Prevents Strategic Surprise: Through development of the described transition technologies, strategic analysis, including analysis of current and potential adversaries' scientific, technological, and weapons capabilities, will improve through the integration of all intelligence capabilities to better anticipate, monitor, and convey warning intelligence and policy-related opportunities.

3. Supports Contingency Response: This program will develop and implement a unified contingency response to facilitate rapid transition to support multiple, concurrent military contingency operations.

4. Names of other Federal, State, or local agencies or parties receiving the proposal or funding the proposed effort;

a. Defense Intelligence Agency: A white paper has been submitted that is similar to this proposal. See Appendix 1, DIA INNOVATION WHITE PAPER.*

5. Date of submission; and

a. September 25, 2014

6. Signature of a person authorized to represent and contractually obligate the offeror.

Mr. Pomeroy

*The DIA Innovation White Paper provides further information regarding this proposal, including substantiated evidence of the importance of this effort and the justification to fund this over competing proposals or projects.

TECHNICAL INFORMATION INCLUDING:

1. Concise title and abstract (approximately 200 words) of the proposed effort;

a. PSYCHOTRONIC AND NEUROWEAPON TECHNOLOGY TRANSFER: It has been shown in classified and non-classified settings that psychotronics and neuroweapons are now a reality that must be addressed (see Appendix 1, DIA INNOVATION WHITE PAPER). The risk to society due to these technologies is extreme. Our entire society is underpinned by the belief that your own thoughts are, in fact, your own. We now know that this is not always the case. Allowing these technologies to invade that basic requirement for our society to proceed is very dangerous and if allowed, will destroy humanity forever. The purpose of this proposal is to offer services for technology transition protocols, in conjunction with my partners, to the DHS. Services will include personal and government security services, among other services that directly support the DHS, the intelligence community and the Federal Government.

2. A reasonably complete discussion stating the objectives of the effort or activity, the method of approach and extent of effort to be employed, the nature and extent of the anticipated results, and the manner in which the work will help to support accomplishment of the agency's mission;

a. As some background, Mr. Pomeroy previously worked for Parsons (a Top Secret Government Contractor) and was involved in top-level technology at the company. His first day on the job was September 10, 2001. We all know what happened the next day. After some disagreements over some issues, he left Parsons but has continued to be involved in a SAP based on psychotronics and neuroweapons. Psychotronics is basically telepathic communication via the brain, helped by technology. We have recently seen some applications of this technology in the commercial sector, such as robotic manipulation via the brain. Likewise, Mr. Obama's recent announcement to "map" the brain is another example, which has already been accomplished. Each word in a language can be mapped to a specific and unique region of the brain. Once each word has been mapped to the individual brain, algorithms and computers monitoring the brain can interpret the brain's regions that "light up" into the actual thoughts and language of the subject. It is known that this technology is being used to torture humans and it should not occur, as noted in Mr. Kucinich's HR 2977 and Federal Assembly, Parliament of the Russian Federation, Governmental Duma, Committee on Safety, Resolution from the 30th of November of the year 2000, No. 28/3. This technology and situation has major implications for the future of humankind. It is the hope of Mr. Pomeroy to work within the system and laws to stop this gross torture of humans and bring this SAP to a conclusion and move forward to the future.

Through a collaborative effort, the anticipated results will be responsible development of our technological prowess to anticipate threats and recognize opportunities, while maintaining or developing stability and maximizing individual freedoms. This project will provide the backbone necessary to implement many technologies that are currently black and classified.

"The vision of homeland security is to ensure a homeland that is safe, secure, and resilient against terrorism and other hazards." The previous paragraph describes a very critical

component of that vision, namely we need a “homeland that is safe, secure, and resilient against terrorism and other hazards.” Further, computer systems have become a mandatory ingredient in exchange, customs and security. Fortifying our computer systems against attack is necessary for economics, exchange and security. The threat in the future to our society from mind-computer interaction will increase, and protocols and measures must be developed to ensure individual freedoms are guaranteed. Even further, we must develop an economic system that accounts for our total resources and is based upon a different system than is currently in place. Our current economic models lack some very important, basic, economic data that I have developed through the mentioned SAP program. A classified reference book, in combination with image evidence, has been created and provides the mathematics behind my theories, in detail.

3. Names and biographical information on the offeror’s key personnel who would be involved, including alternates; and

a. Mr. Lucas W. Pomeroy, B.S. & MBA

4. Type of support needed from the agency; e.g., facilities, equipment, materials, or personnel resources.

a. See Appendix 1, DIA INNOVATION WHITE PAPER. Mr. Pomeroy desires classified or proprietary discussions with the government. Foreign participants or organizations may be involved in this effort. It is anticipated that partnering with others to accomplish the initiative in question will be necessary.

SUPPORTING INFORMATION INCLUDING:

1. Proposed price or total estimated cost for the effort in sufficient detail for meaningful evaluation;

a. The rough order of magnitude for potential funding costs is currently $1 billion, for my portion of the work.

2. Period of time for which the proposal is valid (a 6-month minimum is suggested);

a. This proposal is valid from September 25, 2014 to January 25, 2015. The offeror holds the right to deny this proposal at any time and refuse this service. This is due to the classified nature of the project.

3. Type of contract preferred;

a. The type of contract preferred is single, sole-sourced contract with the caveat that the US Federal Government cannot find this service elsewhere, therefore extremely important and a precedent over other project’s funding. An example contract is included in the Appendix 1, DIA INNOVATION WHITE PAPER.

4. Proposed duration of effort;

a. The duration is dependent upon many factors that need to be addressed.

5. Brief description of the organization, previous experience, relevant past performance, and facilities to be used;

a. BBAD (Buckle & Bernard Agency Developers) is a Top Secret organization developed by Mr. Lucas W. Pomeroy. Its mission is to free the oppressed and assist with ending suffering. We get called when governments need help developing proper “agency.” Most previous experience cannot be discussed in an unclassified proposal. As stated, Mr. Pomeroy previously worked for Parsons Corporation, which is a Top Secret Federal Government Contractor. The facilities to be used will be determined at a future date, but the U.S. Federal Government already has SCIFs, along with other National Governments, that are currently being used in association with Mr. Lucas W. Pomeroy.

6. Other statements, if applicable, about organizational conflicts of interest, security clearances, and environmental impacts; and

a. No organizational conflicts of interest are known at this time. Through implementation of this project, conflicts of interest may arise and may need to be addressed as to why, in the first place, there is an organizational conflict. In proper running governments, there should not be conflicts of interests within the institution(s).

7. The names and telephone numbers of agency technical or other agency points of contact already contacted regarding the proposal.

a. Many people have been contacted regarding this proposal, specifically all top people within the civil government and the military, and people in industry. Secretary Johnson may be aware of this proposal or the white paper.

APPENDIX 1

DIA INNOVATION WHITE PAPER

DIA INNOVATION WHITE PAPER

FOR PSYCHOTRONIC AND NEUROWEAPON TECHNOLOGY TRANSFER

Agency-Wide BAA

DIA-BAA-14-01

Original Posting Date: 27 NOV 2013

Revision 1.0, 23 Dec 2013

CONTACT

LUCAS W. POMEROY

lwpomeroy@yahoo.com

530.219.7595

July 31, 2014

PART 1: POINT OF CONTACT

Lucas W. Pomeroy, MBA
528 Hudson Court
Davis, California 95616
530-219-7595
lwpomeroy@yahoo.com

PART ll: EXECUTIVE SUMMARY

It has been shown in classified and non-classified settings that psychotronics and neuroweapons are now a reality that must be addressed (see Appendix 1, Petition to the House of Representatives Sergeant at Arms). The risk to society due to these technologies is extreme. Our entire society is underpinned by the belief that your own thoughts are, in fact, your own. We now know that this is not always the case. Allowing these technologies to invade that basic requirement for our society to proceed is very dangerous and if allowed, will destroy humanity forever. The purpose of this whitepaper is to offer my services for technology transition protocols, in conjunction with my benefactors, to the DIA. Current attitudes towards this technology will have to change under my leadership. Services will include personal and government security services, among other services that directly support the DIA.

PART lll: OTHER

See Appendix 1, Petition to the House of Representatives Sergeant at Arms. I desire classified or proprietary discussions with the government. Foreign participants or organizations may be involved in this effort. I anticipate partnering with others to accomplish the initiative in question will be necessary. The rough order of magnitude for potential funding costs is currently $1 billion, for my portion of the work.

PART IV: NEEDIPEDIA

The two main capabilities this white paper addresses are as follows. Other areas are also addressed but are not discussed here.

1. Prevents Strategic Surprise

Through development of the described transition technologies, strategic analysis, including analysis of current and potential adversaries' scientific, technological, and weapons capabilities, will improve through the integration of all intelligence capabilities to better anticipate, monitor, and convey warning intelligence and policy-related opportunities.

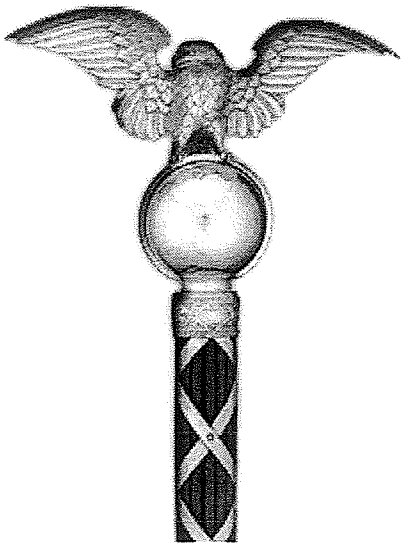
2. Supports Contingency Response

This program will develop and implement a unified contingency response to facilitate rapid transition to support multiple, concurrent military contingency operations.

PETITION PACKAGE

PREPARED FOR

UNITED STATES HOUSE OF REPRESENTATIVES
SERGEANT AT ARMS



BY
LUCAS W. POMEROY

June 28, 2014

LUCAS WHITMAN POMEROY
528 HUDSON COURT
DAVIS, CA 95616
530.219.7595
LWPOMEROY@YAHOO.COM

June 28, 2014

Paul D. Irving, Sergeant at Arms
US Capitol, Room H-124
Washington, DC 20515

Re: Petition Package for the Sergeant at Arms

Dear Sergeant at Arms:

Thank you for the return call. The enclosed package is for your files. Please retain. The following has been provided to many people within the United States Federal Government. I am contending that the President and others have committed treason, are corrupt and are torturing people. All offenses that I think are punishable by the House. Additionally, they are guilty of breaking the Electronic Communications Privacy Act, as amended in Title III of the Omnibus Crime Control and Safe Streets Act of 1968 (the Wiretap Statute), and have illegally tapped information from myself and others through the use of electromagnetic and ultrasound technology. "Electronic communications" means any transfer of signs, signals, writing, images, sounds, data, or intelligence of any nature transmitted in whole or in part by a wire, radio, electromagnetic, photoelectronic or photooptical system. These individuals have private information about me that has been illegally acquired and are guilty of intruding upon my privacy even after they have determined I was neither a threat nor a criminal, and they continue to do so.

These individuals are active in the United States Senate and House, in the White House, in the Judicial branch and in many Federal Government agencies. As I understand it, the Sergeant at Arms would have jurisdiction, if for example, someone was preparing to commit a treasonous or criminal crime or a civil crime, for which all have occurred. Just because much of this is classified does not make it legal, moral or ethical.

Because of their actions, I feel that my life has been put in physical danger. As an example, follows is an email from Army Intelligence after I had a long phone conversation with them. I thank the Sergeant of Arms for maintaining high values and blind eyes towards justice. I would recommend reading enclosure one first. It provides some important context and background surrounding my accusations. Should you like, I would be more than willing to discuss this matter with you. Thank you for your attention to detail.

Classification: UNCLASSIFIED
Caveats: My Default Caveat

Mr. Pomeroy,

Thanks for taking our call today. Please remember that if you feel like you are in physical danger, your very first line of defense is to call your local police department. Very respectfully.

INSCOM Public Affairs Office 703-428-4965

Sincerely,

Lucas W. Pomeroy

Cc: United States Federal Government Personnel
Enclosures: One) IQ Intel Article, Interview of Dennis Kucinich; Two) Petition for Judicial Complaint No. DC-14-90001

ENCLOSURE ONE

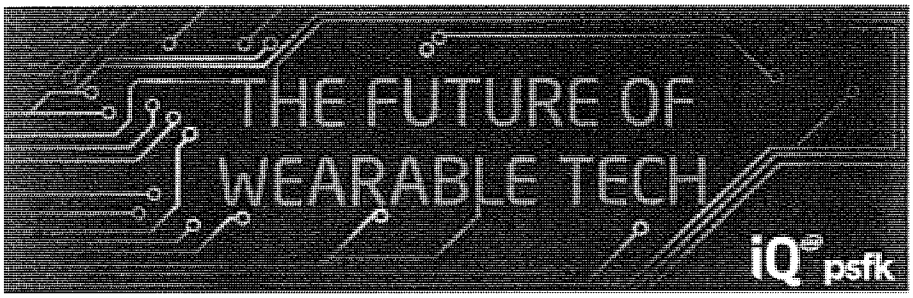
IQ Intel Article

&

Interview of Dennis Kucinich

ENCLOSURE
ONE

In The Future of Wearable Tech, iQ by Intel and PSFK Labs explore the evolving form and function of our Internet-connected devices. This series, based on a recent report, looks at the rise of wearable technologies and their impact on consumer lifestyles.



As we move into an era where we are increasingly dependent on our devices, even being without your phone for a few hours can feel rather disorientating. Now imagine that same scenario ten years from now when these same technologies are even further embedded into the fabric in our lives.

Science fiction novels and works of pop culture play out these promising and often scary scenarios, but in reality humans are rapidly leveraging the advances in computational size, processing speed, and sensor technology to augment our natural abilities.

Far from dystopian, the future of this hybrid human and machine mix offers the incredible possibility to replace or correct for limitations caused by degenerative conditions or other physical and mental shortfalls. A trend that could be called "Augmented Sensory Perception" is rising from early experiments that closely align and even integrate technologies with the human body to enhance existing perceptions and faculties. Whether through biomedical research or DIY 'hacks', these innovations are designed to overcome personal challenges, while pushing the boundary in terms of what is possible.

RELATED CONTENT


BODY ARTIST TURNS TO SCIENCE AND TECHNOLOGY TO SHAPE THE FUTURE
+ SHARE


LOOKING AT LIFE WITH ALWAYS-ON MEMORY
+ SHARE


THE WEARABLES PIECING TOGETHER A DIGITAL SCRAPBOOK OF OUR LIVES
+ SHARE

Intel's futurist Brian David Johnson spends a lot of time talking with researchers, science fiction writers and roboticists to understand how technologies might further enmeshed into our lives. Despite being increasingly device dependent, he believes tomorrow's future we will remain humans centric and mixed with emotional experiences and desires.

"The stories we tell about the future frame the constructs for what actually becomes reality; so it is up to us to articulate the narrative we want to see unfold," he said. With that in mind, he looked into the future through the lens of today's growing trend of wearable technologies.

What shifts are driving the next wave of technology development?

As we approach the year 2020, the size of computational power begins to approach zero and you can turn anything into a computer. You don't have to ask yourself, "Can you do it? Can you augment your clothes or your body?" The question becomes what do you want to do, and why do you want to do it? It's not just one chip or device. It's a bunch of devices working together; devices that are in your purse, and on/in your person.

What is the ultimate goal of these technology-related experiences?

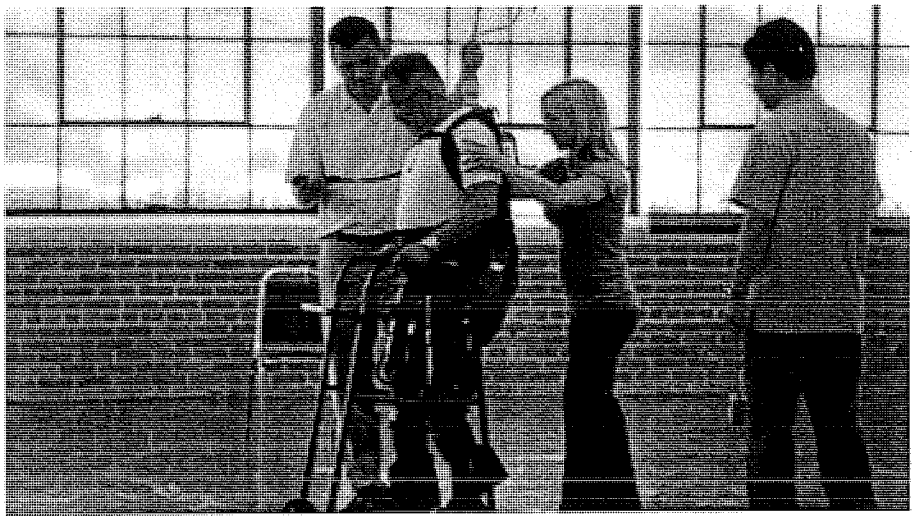
The relationship you have with your technology is no longer command and control. That doesn't mean it's a human relationship, but only that your technology will know you and it will understand you.

The question is how can we use this technology to not only make people more productive, but to make them healthier, happier and entertain them more. If we set the bar at that height, we'll come up with awesome technology, but we'll also be able to do so much more. Ultimately the goal is to use this technology to make people's lives better.

Talk to us more about this idea of relational computing?

As human beings we are really good at relationships. We've had scientists who have been studying human relationships for longer than computers scientists have been studying computers, so we've got this deep, rich area of knowledge that we can tap into for requirements.

You have to know who a person is; that they exist in a culture and a relationship. In that way, it becomes very personal. For a long time, we've been talking about personal computing. To be understood as an individual is one of the things that's very inherent to us as human beings. Being an optimist, I think having this relationship-based interaction with technology actually should make this interaction much more human.



How does this relate to augmenting our bodies?

Remember humans have been augmenting themselves with tools for centuries. Our tools become extensions of ourselves and are imbued with our humanity, our sense of values, and with our culture. If these tools start going into our bodies, we start to understand them better and this means that they're making our lives better.

Now these tools are fixing what's been lost, or they're enhancing something we need them to

and giving us things that they couldn't have given us before. Some of that's health, but also some of it is self-expression. Think about tattoos. There is no reason for somebody to take ink and put it inside of their bodies under their skin.

It's a form of self-expression. At one end, you have a paraplegic or a quadriplegic using technology to make their lives better. But at the other end, you have somebody who is putting a tattoo on their body as a form of self-expression. It's this great range of self-expression.

As the technologies you put onto your body to augment or otherwise, know you as an individual, it will actually understand you. So the next step becomes, what are you attempting to augment and why?

How do these technologies become mainstream?

I think what we're seeing today, and what we will continue to see for the next five to ten years is that human beings are changing the story about how we will live with this new technology.The future is not a set point on the horizon that we're all running towards, helpless to influence. The future is built by people every day.

One of the most powerful things I discovered is that if we change the story people tell themselves about the future they're going to live in, they will change the future. We need to tell those new stories, art and science fiction because they are radically different and that's how we start to understand.

Then we have more conversations, and those conversations manifest themselves in works of art, new performances, and new stories in the press. We slowly, bit by bit, begin to change what that vision of the future is, and then those technologies will come into the mainstream. We have to imagine what those futures are going to be, and then the rest is just engineering.

How do we ensure the best possible future?

We need to be mindful of our responsibility to these tools. We can use science fiction to portray consequences, to map out not only the future that we want, but the future that we want to avoid.

There's always going to be unintended consequences, but we can be diligent about it, and ask ourselves, "What can we do from a technology standpoint to avoid those futures?"

We have so much, that when it comes to those consequences it's actually about human beings; the technology doesn't get to decide. Most of the time it's not a technology discussion, it's a people discussion.

World RSS

INTERVIEW: NATO 'Anachronistic Nightmare' and Should Be Disbanded – US Politician

Dennis Kucinich

19:31 08/04/2014 © East News

MOSCOW, April 9 (RIA Novosti) – In an interview with RIA Novosti, veteran US politician Dennis John Kucinich – who twice ran for president and served in the US Congress for 16 years – shared his vision of the role that NATO and its member states play in political crises of global significance, including the ongoing unrest in Ukraine and the civil war in Syria.

First of all I'd suggest discussing recent events in eastern Ukraine. Crowds of pro-Russian demonstrators stormed government buildings Sunday in two major cities of the region. Is it fair to say that this is the people's reaction to the coup in Kiev?

First of all everyone knows the junta in Kiev was installed by a coup and that you have nationalists, neo-Nazis who came to power as a result of that coup. One of the first things that happened was linguistic rights were attacked. And the population which had used the Russian language was suddenly aware the Russian language was under attack. And this of course created a backlash.

You know, when you have a country where so many people have Russian as their first language, this was something that threw a lot of fear into people. And who is going to protect the rights of people to be able to assert their cultural identity? That's really the question here. And that's why the people in Crimea voted not just to be formally considered part of the republic, but they also voted to protect their cultural identity. Because that was one of the things that was under attack.

But there is a much larger question here. As we speak, you have NATO training Right Sector. Now they are being brought into the military and trained with heavy weapons, and this can only be to engage in very violent military confrontation. This is very bad. And what is ominous is that we are speaking about neo-Nazis.


Crimea in Pictures


Russia Conducts Live-Fire Air Defense Drills in Siberia. Photos


We Are the Champions: Russian Olympic Figure Skaters Perform in Sochi


Gorilla at San Diego Zoo and Other Animal News.Photos

Russia Beyond the Headlines


Burger King to open in Crimea as McDonalds pulls out


The cartographic fall-out over Crimea

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- Putin Says Further Violations by Ukraine Will Compel Russia to Cut Off Gas
- INTERVIEW: NATO 'Anachronistic Nightmare' and Should Be Disbanded – US Politician
- Second US Navy Destroyer to Arrive in Black Sea by Thursday

Why does the US not pay enough attention to the new Ukrainian government's close ties with radical groups?

I think that there is a lack of understanding in the United States of the significance of the neo-Nazis coming to power. Because anyone who is familiar with the history of World War II knows that Russia lost 30 million people. Anyone who is familiar with the battle of Moscow knows that two million people put their lives on the line to defend the city. And the memorial which is on the road from Sheremetyevo into Moscow of those tank barriers serve as a grim reminder of the millions of Russians who put their lives on the line to defend the city and the country against Nazis.

Russians did not give their lives so that 70 years later neo-Nazis could come to power, who were trained by NATO to attempt to camp out on the Russian border in Ukraine. That's simply not acceptable. And this lack of historical understanding is at the center of the inability to understand Russia's response to these recent events.

I pointed out as you've probably read, I was one of the first people in the West who actually dissected the so-called trade agreement that Yanukovych was being forced to sign. And I pointed out that it was actually a military agreement masked as a trade agreement that enabled NATO to go to the Russian border. And this of course has been NATO's dream, its justification for its existence. The only problem is that it's historically out of context. NATO doesn't really have a legitimate reason for a continued existence. So they are trying to create one by participating in this series of events which have captured the entire world's attention.

But people have to understand that what we are seeing here goes back to World War II and that for some people connected to NATO World War II is not over. Look at the people who were running NATO military operations in 1961 and their own connections to the Nazis. You have to ask yourself what's going on.

Some people think that this is just a continuation of the Cold war. No. This is a continuation of a hot war, of one of the worst tragedies the world had ever seen: World War II. There was a general who was, if I remember correctly, who was a Nazi chief of land forces that carried out operation Barbarossa and he ended up as a military chief of NATO appointed in April of 1961.

So when you look at this, for certain NATO elements, World War II never ended. When you have openly pro-Nazis who are rising in power, who are being given participation in a national army, Russia has every right to be concerned. And the US, our leaders, need to bone up on our history to understand what is at stake here. This whole conflict is not necessary.

And you know, there are many other elements to it, there are other outcomes that deal with trade, energy markets, currency. But the key to understanding this is to understand the suffering of the Russian people and the Ukrainian people at the hands of the Nazis in WWII.

And this whole exercise – which has been dressed as an attempt to give the people of Ukraine benefits of association with the European community – is in no way going to benefit the people of Ukraine, even given the trade agreement that Yanukovych rejected. There were no guarantees for the Ukrainian people of being able to get jobs in the EU. It's very clear the EU doesn't want Ukraine. The economy of Ukraine is in shambles. Not because of Russia but because of kleptocrats who have taken advantage of the people of Ukraine. You know – having high office there is like a license to steal.

Do you believe that the United States government was funding some of the violent rebel groups in Ukraine who overran the country?

What we know is this. It's on the record that the US sent $5 billion to help various groups in Ukraine. We know that USAID resources were involved. We know that the National Endowment for Democracy, which was involved in so many orange revolutions, was involved in these efforts.

Do we know that any of that money went to Right sector? I don't know. But try to imagine when billions of dollars are pouring into the streets, that this money does not end up in the hands of people who are violent.

The people in Ukraine had legitimate grievances against their government. And many people were sincere. The unemployment, low wages, the conditions in Ukraine have been very bad for people. So of course they are going to go and gather in a place where historically Ukrainians had come together to express their concern about what's going on in their country.

But what's happening now is that these violent neo-Nazis effectively surfed that moment and used it to gain control of a number of seats in the cabinet, including those which are very security sensitive. So of course Russia would be concerned about that. Every country has its own interest.

And US policy which is guided by military, and by energy interest, and economic interest

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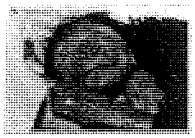
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is sometimes just plain wrong. And this is an example. I don't think that President Obama is looking for any kind of military showdown with Russia. I do think that NATO is trying to justify its existence.

You know NATO's last big exercise was in Libya, which was a total disaster. What's NATO about? The North Atlantic is not on the Russian border, not on the Chinese border. And that's what we come to – NATO is an anachronism.

And because it's an anachronism it is trying to see how it can justify its existence by interposing itself in a conflict and stirring it up. Otherwise it wouldn't be training Right sector troops right now or bringing them into the military. This idea that somehow Kiev, and Washington, and NATO are going to tame Right sector is a myth. That is not happening.

There is a split between the new Ukrainian government and some radical groups. Is it possible to provide weapons for Ukraine under these circumstances?

I disagree with my friend Senator McCain. Because as we speak, Right Sector is getting access to heavy weaponry through NATO and being trained. That's very dangerous. And the government in Kiev, the junta rather in Kiev, has the idea that they are going to bring the Right Sector to work in the National guard on domestic matters, to bring them into the Ukrainian military.

But they are talking about the most violent people who helped to precipitate street violence. It again brings up a spectrum of things that came out of Nazi Germany and World War II. We need to be very careful not to continue to inflame this crisis because Russian-speaking people, particularly those in east, see the rise of neo-Nazis and feel a threat to their cultural identity.

How would you comment on Kiev's cooperation with foreign private security firms, such as Greystone?

We saw in Iraq how private security forces can get out of control. Whenever you are in a politically sensitive, a militarily sensitive situation, the last thing you want is private security out there, because they can actually profit by an expanded conflict.

They can stir up a war and then profit from it. And then they can leave and take their money with them. I'm totally opposed to private armies being involved in any actions anywhere. If oligarchs want to hire people to protect them, they have a right to do that.

But if nations bring in private armies you are looking at combustible material here because there is no control. The private armies will pursue private interests. Which is what they do, because they are private. They don't care about anything except making more money. And the more war there is, the more money they make. And when they walk away from carnage and all the dead bodies of people whose homes and lives have been destroyed, they go right to the bank. That's not acceptable.

Does Washington have any influence over them? Does the administration realize that these companies' actions can trigger a civil war?

It can set terms that establish that the armies will not receive any aid in any Western organization. They can set these terms. You know the only money that Ukraine is getting right now is from the IMF. Who is paying these private armies? And the IMF of course is going to make life even more miserable for the people of Ukraine. So you should ask who is paying these private armies. I don't know yet, but if it's somebody in the West, that's a provocation. There is no control. And provocation leads to escalation.

Is it in the interest of the United States to impose further sanctions on Russia? Can Obama find any compromise or will it be hard for him to withstand the pressure of neoconservative groups?

Well, I think we first have to say that sanctions are counterproductive. Russia is going to defend itself against neo-Nazis no matter what kind of sanctions Washington puts up. And in addition to that, Russia has already demonstrated a willingness to firm up other alliances, with China for example, and move to establish new energy markets.

What's happening in the US by the way is that US is undertaking an unprecedented increase in the production of natural gas through a process called fracking, which is environmentally very damaging. We've done this in the name of energy independence. We've ended up with a tremendous surplus of natural gas, so much that a number of terminals have been built for the export of that natural gas.

The US energy interests are seeking new markets. The cutting off of Russia's access to Europe happens at a time when US energy interests are seeking new markets. That's a fact. So what will happen? The surplus of the natural gas that exists in the US right now, which is supposed to be our key to energy independence, is going to end up being sold to the EU at a high price. And the EU is encouraged to begin to frack. And energy prices in the US will go up because the supply will become artificially low as a result of the

exports.

In the meantime, Russia understands that it's not going to play the game and it's going to seek other markets. But what's going to happen – the people in Ukraine will pay more for gas, for fuel, the people in Europe will pay more for fuel, and the people in the US will pay more.

What's this about? When you look at this all of Europe will end up increasing their arms budgets, the US will end up increasing arms budgets, and NATO will get more money. This is a racket. And any trade agreement that Ukraine signs will not end up benefiting the people of Ukraine. It will open markets for goods from Europe.

How do you assess US media coverage of the crisis? Why has US media not paid attention to claims the opposition was behind sniper fire in Kiev?

First of all it's generally accepted that people who stir things up can be found in the escalation of any crisis. This is how out-groups become in-groups, how they come to power. And the fact that there wasn't a thorough investigation of the fact that police and demonstrators have been shot – it's astonishing that it hasn't been pursued what's happened.

And a prevailing approach in the US has been to feed a narrative that ignored the fact that a coup took place, that ignored the fact that neo-Nazis came to power, that ignored the fact that there was evidence that people were shooting both police and demonstrators at the same time in order to stir up a conflict in Kiev. Because the focus is on a cartoon version of events which feed old Cold War narratives, which should have been discarded when the War came down.

Was it Washington's ultimate goal to replace Yanukovych when the situation got out of control?

A State Department official was caught on tape before the coup stating exactly who would be put in power. How did that happen? It was already decided that Yanukovych was going to be out. It was decided when he refused to sign a six-thousand-page agreement that did not benefit Ukraine, that put NATO on Russia's border.

And that essentially was the end of the attempt of the Ukrainian people to have any kind of neutrality on these issues. Then you end up with Yatsenyuk, but even he has been careful about how far he can go. There will be an election. But no matter what the election brings, the fact that you have Ukraine being a staging ground for a contest between interests – that was precipitated by the West – you have to understand that the last people who can benefit from it are the people of Ukraine.

And this is a tragedy. One that was preventable. And one that does not have to escalate. Because I don't think that the Obama administration really wants to escalate this. And the people who are pushing for escalation in this country are the same people who took us into Iraq, who took us into Afghanistan and into Libya, all disasters that have to a great extent hurt the American people.

We need to rebuild, we need to make an effort to rebuild our relationship with Russia. We need a better understanding of the people of Russia and of their history. We need to stop playing Cold War games. And we need to treat each other with respect and stop the rhetoric which is designed to humiliate people.

Why does Europe, remembering the atrocities of World War II, support radical groups? Why does it support sanctions which can damage its own economy?

There is a combination of things going on here. One is that the US has been pushing. NATO has had a great influence. If you look at the member nations it coincides closely with the EU. So you have some of the same interest groups who are involved.

But I think that European leaders as NATO escalates have to be very concerned that ultimately their interests are going to be affected. If this crisis continues to escalate, it will have an impact on every single country in the European Union. And not just in terms of damage to the economy, but in higher prices – creating security problems which did not have to happen.

We need to expect that our political leadership will come to an understanding that we can no longer participate in the power politics of old. Look, Russia and the US have painstakingly built a friendship after experiencing a period of mistrust and potential for conflict.

We've forgotten the Cuban missile crisis? I haven't forgotten how as a child I and other children were sent to drills which we called "duck and cover" because we were taught that there was going to be a nuclear attack on America from Russia...

We have to find a way to reestablish a strong relationship, and the only way you can do it is through respect, knowing the strength that each country has in order to understand that we should not be about one country trying to dominate another.

And what is the main obstacle?

NATO. It's an anachronistic nightmare. It really ought to be disbanded. It has become a protection racket. That what the mafia did in the US in the 1930s.

Would you comment on the report that Turkey could be involved in using chemical weapons in Syria to provoke a US strike?

I think once President Obama established the red line every provocateur who wanted the US in was given an incentive to do so.

There is no question that the US was being set up and I think that President Obama finally realized that. And that's why he decided not to go forward. And where this came from we don't know yet. I saw Mr. Hersh's article in the London Review of Books. And it's worth reading. And it's worth considering.

But look, how many countries began to play in Syria, began to send jihadists into Syria. And why? There is a geopolitical case here. That Russia with its base in Syria... and Russia helped to bring the world away from the brink of a conflict over Syria, Russia which has a role with Iran, that Russia has somehow been made to pay the price by the neocons whose efforts to stir up a war in Syria were deflected by Russian involvement and diplomacy.

But who was trying to set it up? Maybe Turkey was involved. I don't know that. But it's worth considering that other nations' interest come to play and this is old thinking. We have to stop pretending that anyone is going to build an empire any more. No one can afford it. That's the bottom line. People have enough trouble managing their own affairs. The USSR is not going to be reconstructed. The British Empire is not going to be reconstructed. And frankly we are learning in the US the cost of empire building. We can't afford it any more. This is a time for diplomacy and a time for de-escalation.

This is also a time for understanding history. Because Crimea was not the Sudetenland. The Russian troops were already in Sevastopol. And they were there because of a treaty. We have to understand history here.

When I took my first trip to Russia 30 years ago and I went down the road between airport and the city I saw those tank barriers set up there as a memorial. That's a lesson. We must not forget the suffering of the Russian people and the Ukrainian people, we must not forget the role that the Nazis played trying to crush Russia. This was Hitler's plan and he did not succeed.

And it was the US and Russia which ultimately stopped Hitler's plan from being realized. We don't forget the price that Americans paid. And we don't forget the price that Russians paid. And it's absolutely wrong for anybody connected with America to in any way, shape or form help for neo-Nazis to come to power so that they can be aggressive against Russia. In America we believe in freedom and we cannot let these people, who want to destroy freedom, gain as a result of some geopolitical game.

The Office of Inspector General has identified significant vulnerabilities in the management of contract file documentation that could expose the State Department to substantial financial losses. In your opinion, is it just a bureaucratic issue or could it be evidence of corruption?

Any time money is missing in the government it goes somewhere; it goes into somebody's hands. No one is maintaining this is an accounting problem. It's a problem of accountability. The question is whose hands does it go into. What purpose has it been used for. That's the question. And that has not been determined yet. As a member of Congress I saw many occasions in which billions of dollars had not been accounted for.

When you have a nation that is spending trillions, a billion might not seem like a lot of money, but it is a lot of money. And when the State Department cannot account for money, we have to ask for what purpose it was directed.

Any time you are responsible for billions of dollars you have to say where the money is going. And when it disappears it's a huge problem. I mean – was it stolen, was it misappropriated, was it misdirected?

The American people are already paying too much in taxes. And every taxpayer has to be concerned about this. People are taxed heavily and when they see that kind of money disappear they become alarmed, they have every reason to be upset. We are cutting back a number of programs for social welfare and at the same time billions of dollars can disappear from the State Department account. Unbelievable!

What can the US and Russia do to overcome disagreements and improve relations?

As a member of Congress I traveled to Russia many times to meet with officials and to try to develop relationships, I worked with the Russian and American Chamber of Commerce to try to find ways in increasing commercial exchanges. I worked to build

relationships and friendship.

And when I look at this I'm very concerned about relationships here which have been destroyed. We don't need to idealize each other. Each nation has its own challenges and own problems. But there needs to be respect and that's been lost. And that's a problem.

I'm continuing to write about this, to speak out whenever I have an opportunity, because what I see happening here is a totally unnecessary escalation of a conflict in which there will be no winners. We have to go back to working diplomatically.

I think it's very important to talk to you. I've served 16 years in the US Congress, I ran for the Democratic nomination on two occasions and I've been a very vocal supporter of diplomacy and of "strength through peace" and I continue to do so.

Hopefully this period is not going to escalate, but it's dangerous. People in Russia need to understand that there are some people in the US who know exactly what's going on, so that they know that not everybody here is just getting swept up in propaganda. I believe very strongly in the importance of a good relationship between Russia and the US.

Dennis John Kucinich is a former U.S. Representative from Ohio, serving from 1997 to 2013. He was also a candidate for the Democratic nomination for President of the United States in the 2004 and 2008 presidential elections.

in Russian Navy

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SATURDAY, MAR 10, 2012 02:40 AM PST

Dennis Kucinich and "wackiness"

The now-defeated congressman consistently opposed destructive bipartisan pieties -- and is therefore "crazy"

GLENN GREENWALD Follow

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Rep. Dennis Kucinich (Credit: AP Photo/Harry Hamburg)

Last week, Rep. Dennis Kucinich was defeated in a Democratic primary by Rep. Marcy Kaptur after re-districting pitted the two long-term incumbents against each other. Kucinich's fate was basically sealed when the new district contained far more of Kaptur's district than his. His 18-year stint in the House will come to an end when the next Congress is installed at the beginning of 2013.

Establishment Democrats have long viewed Dennis Kucinich with a mixture of scorn, mockery and condescension. True to form, the establishment liberal journal *American Prospect* gave Kucinich a little kick on the way out, comparing his political views to the 1960s musical "Hair" (the Ohio loser talked about "Harmony and understanding"!), deriding him as "a favorite among lefty college kids and Birkenstock-wearers around the country," and pronouncing him "among the wackiest members of Congress." Yes, I said *The American Prospect*, not *The Weekly Standard*.

The *Prospect* article also praises as "great" a snide, derisive *Washington Post* piece which purports to "highlight some of the **particularly bizarre** facts about" Kucinich. Among those is the fact that "he introduced impeachment articles against former President George W. Bush and former Vice President Cheney for their roles in the Iraq war" and "proposed a Cabinet-level agency devoted to peace." What a weirdo and a loser. Even more predictably, a team of four interns at *The New Republic* – the magazine that spent years crusading for the attack on Iraq, smearing Israel critics as anti-Semites, and defining its editorial mission as re-making the Democratic Party in the image of Joe Lieberman – denounced the anti-war Kucinich as "ludicrous," citing most of the same accusations as the *Prospect* and the *Post*.

Revealingly, two days after the *Prospect* article crowned Kucinich "among the wackiest members of Congress," TPM featured this article, the day after Eric Holder advocated the view that the President has the power to target American citizens for execution without charges:

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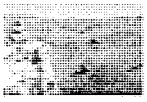
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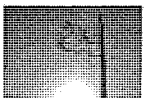
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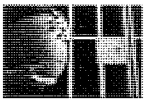
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ELIAS ISQUITH

So let's recap the state of mental health in establishment Democratic circles: the President who claims (and exercises) the power to target American citizens for execution-by-CIA in total secrecy and with no charges — as well as those who dutifully follow him — are sane, sober and Serious, meriting great respect. By contrast, one of the very few members of Congress who stands up and vehemently objects to this most radical power — "The idea that the United States has the ability to summarily execute a US citizen ought to send chills racing up and down the spines of every person of conscience" — is a total wackjob, meriting patronizing mockery.

Both the *Prospect* and *Post* recite the trite case demonstrating Kucinich's supposed weirdness. He's friends with Shirley McLaine, who believes in reincarnation, and he once (according to McLaine) claimed to have an encounter with a UFO. Is any of that really any more strange than the litany of beliefs which the world's major religions require? Is Barack Obama "wacky" because he claims to believe that Jesus turned water into wine, rose from the dead and will soon welcome him to heaven? Is Chuck Schumer bizarre because he seems to believe that there's some big fatherly figure sitting in the sky who spewed fire and brimstone at those who broke the laws he sent down on some stones and now hovers over him judging his every move? Is Harry Reid a weirdo because he apparently venerates as divine the "visions" of a man who had dozens of wives, including some already married to other men?

Neither the *Prospect* nor the *Post* would ever dare mock as "wacky" the belief in invisible judgmental father-figures in the sky or that rendition of life-after-death gospel because those belief systems have been deemed acceptable by establishment circles. "Wacky", like its close cousin "crazy," is a term of establishment derision exclusively reserved for those who deviate from such conventions. And that's the point worth making here: the real reason anyone with D.C. Seriousness, including many establishment liberals, relished mocking Kucinich is because he dissented from the orthodoxies of the two political parties. That, by definition, makes one wacky and weird, even when — as is true for the Obama assassination powers and so many other bipartisan pieties — the actual wacky and crazy beliefs are those orthodoxies themselves (we've seen this repeatedly with those who stray from two-party normalcy). In reality, the **actual** crazies are those who fit comfortably within that two-party mentality and rarely challenge or deviate from it, while those who are sane, by definition, dissent from it (just today, the Super Serious Democratic Sen. Carl Levin, a prime co-sponsor of the indefinite detention bill passed late last year, called for a naval blockade of Iran).

In a 2010 *Newsweek* article, Conor Friedersdorf perfectly described how this "crazy" appellation is used by the small-minded to enforce bipartisan beliefs and limit the realm of sanity to the suffocatingly narrow range of opinions permitted by the two parties:

> Forced to name the "craziest" policy favored by American politicians, I'd say the multibillion-dollar war on drugs, which no one thinks is winnable. Asked about the most "extreme," I'd cite the invasion of Iraq, a war of choice that has cost many billions of dollars and countless innocent lives. . . .
>
> I hardly expect the news media to denigrate the policies I've named, nor do I expect their Republican and Democratic supporters to be labeled crazy, kooky, or extreme. **These disparaging descriptors are never applied to America's policy establishment, even when it is proved ruinously wrong, whereas politicians who don't fit the mainstream Democratic or Republican mode. . . . are mocked almost reflexively in these terms, if they are covered at all. . . .**
>
> [I]s it not just as extreme that President Obama claims an unchecked power to assassinate, without due process, any American living abroad whom he designates as an enemy combatant? Or that Joe Lieberman wants to strip Americans of their citizenship not when they are convicted of terrorist activities, but upon their being accused and designated as enemy combatants? . . . **[C]razy, kooky, extreme actions are perpetrated by establishment centrists far more often than by [those typically derided in mainstream circles as crazy].**

The current President not only has seized the power to assassinate American citizens with no charges, but also to imprison people indefinitely with no charges, to bomb six different countries where no war is declared and where civilians are routinely killed, to invoke extreme, self-parodying levels of secrecy to hide what he does, and to prosecute wars even after Congress votes against their authorization. His cabinet is filled with people who, while in public life, advocated an aggressive attack on another country on the basis of weapons that did not exist, including his Vice President and Secretary of State. His financial team is filled with the very same people who implemented the Wall-Street-subservient policies that led to the 2008 financial crisis. Despite all that, it would be unhealthy in the extreme to hold your breath waiting for the *Prospect* or the *Post* to mock any of them as crazy or "wacky," because what they advocate — as crazy as it is — fits comfortably within the approved orthodoxies of establishment Washington.

Meanwhile, the crazy wacko, Dennis Kucinich, has been an outspoken opponent of all of that. In a rational world, that would make him sane and those he opposed crazy. But in the world of Washington's political and media class, it's Kucinich who is the crazy one and those who did all of that are sane and Serious. Put another way, the chickenhawk warmongers at *The New Republic* are normal, while the anti-war Kucinich is "among the wackiest."

It's not difficult to see why Democrats, including progressives, often took (and continue to take) the lead in demonizing Kucinich as a wacky loser. After his Party leaders decreed that impeachment of Bush was "off the table" — both because they feared it would jeopardize their electoral prospects and because top Democrats were complicit in Bush crimes — Kucinich defied their orders and introduced articles of impeachment against Bush for the Iraq War, his chronic lawbreaking, and his assault on the Constitution: exactly what impeachment was designed to prevent and punish. He was one of the very few people in Congress who vehemently denounced the assaults on the Constitution with equal vigor under the prior GOP President and the current Democratic one. He was one of the very few people in Congress with the courage to deviate from the AIPAC script, opposing the Israeli blockade of Gaza, condemning Israeli wars of aggression, and repeatedly publicizing the oppression of Palestinians with the use of American funds and support. He repeatedly insisted on application of the law to the Executive Branch's foreign policy when all of Washington agreed to overlook it. He repeatedly opposed bipartisan measures to intensify hostility toward Iran. When the Democrats won Congress in 2006 based on a promise to end the Iraq War, only to turn around and continue to fund it without restrictions (thus ensuring that this politically advantageous war would be raging during the 2008 election), Kucinich continuously demanded that they follow through on their promises.

In the domestic policy area, Kucinich typically defended the values which the Democratic Party claims to support even as it assaults those very values. As *Progressive* wrote this week, "Kucinich was fearless in standing up to corporate power, in denouncing NAFTA and GATT and the WTO and the fallacy of free trade, in criticizing the Federal Reserve Board for not doing more about unemployment and for bailing out the banks" and he "campaigned mightily for universal single-payer health care" (though, under heavy pressure and threats, he supported

Obama's health care bill at the last moment). Kucinich vocally criticized President Obama for proposing substantial cuts to Social Security. He became an increasingly outspoken critic of the Drug War. *The Nation*'s John Nichols this week praised him as "one of [Congress'] steadiest critics of corporate power." Those noble fights were often waged against his own party's leadership, with risk to his own political fortunes, and with very few allies.

One criticism of Kucinich that is not unreasonable *per se* is that he has no real legislative accomplishments to show for his 9 terms in Congress. Citing that criticism, Andrew Sullivan this week branded him "A Forgettable Ideologue"and quoted from an anti-Kucinich post in The *New Yorker* (yet another Serious, Sane magazine that played a key role in fueling the flames of war against Iraq). The *New Yorker* post is entitled "Why Kucinich Won't be Missed," in which Alex Koppelman argues:

> For all of his advocacy for liberal issues, Kucinich got almost nothing accomplished. He's one of those legislators who becomes a favorite of the base — this happens on both sides; look at Michele Bachmann — by talking a lot while doing very little. Effective legislators build
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> what's
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> nember him by.

I find this unpersuasive on multiple levels. For one, enacting legislation is not the only way to have an important impact on our political culture. Shining light on otherwise-ignored issues, advocating rarely-heard political positions, using one's platform to highlight the corruption of those in power and to challenge their warped belief systems are all vitally important functions. Advocacy of that sort may not produce immediate, tangible successes, but it is a prerequisite for changing prevailing political mores and persuading citizens to think differently. "Talking a lot" is a synonym for persuasion, advocacy and debate. It's far from "doing very little." Those are all critical steps in changing a political system. It's true that Kucinich cannot point to any law he passed that, say, guts the National Security State or corporate-lobbyist control over Washington, but that hardly means his work was inconsequential. Those types of changes often take years, even decades, of advocacy, and urgently need those with public platforms to amplify the underlying views to change how citizens think.

But more important: Kucinich's animating belief was that both political parties often embraced extremist, destructive policies due to a combination of cowardice and malignant views. He usually resided outside of the bipartisan mainstream. He was often right when the Sober Centrists and Party leaders were dreadfully wrong: on Iraq, on the extremism of the Bush assault on the Constitution and rule of law, on America's self-destructive and immoral blind support for Israel, on the subservience of Washington to a corporatist and Wall Street agenda. He was one of a tiny handful of people willing to bravely challenge those orthodoxies and the imperatives of lobbyist rule. It's not his fault that most of his colleagues and the broader political class clung to those destructive pieties and cowardly served those who own and control Washington.

Would it have been better if he had won more fights? Sure. Could he have been a more shrewd and calculating political operative? Probably. But his failure to get Washington to see the wretched errors of its ways reflects far more on them than it does on him. Faced with a militarized and corporatized state and a cowardly political and media class that enables it, Kucinich did what he should have done: opposed it loudly, courageously, consistently, and passionately.

In sum, Kucinich was one o ent to his beliefs outweighed both his cal office. He thus often highlighted the se ts and their Party as well as the broader and wacky. He's long been delivering a Washington generally, and like all unwar so that this criticism disappears. Thus, t eral, citizen assassinations, the systemat Terror, the financial collapse, the destru supremacy of banker-criminals are sane a those assaults, like Dennis Kucinich, are the "wackiest."

Such self-affirming pronouncements will make those who passively acquiesced to all those

policies and who support the politicians who brought them to us feel much better: sure, Kucinich stood stalwartly against them all and warned us of their dangers while I cheer for politicians who bring us these things, but *he believes in UFOs and impeachment and a Department of Peace. What a wackjob.* That's what the "crazy" insult enables and why it's so popular in the halls of political and media Seriousness.

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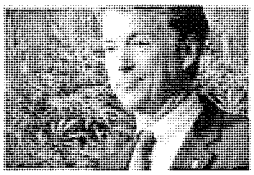

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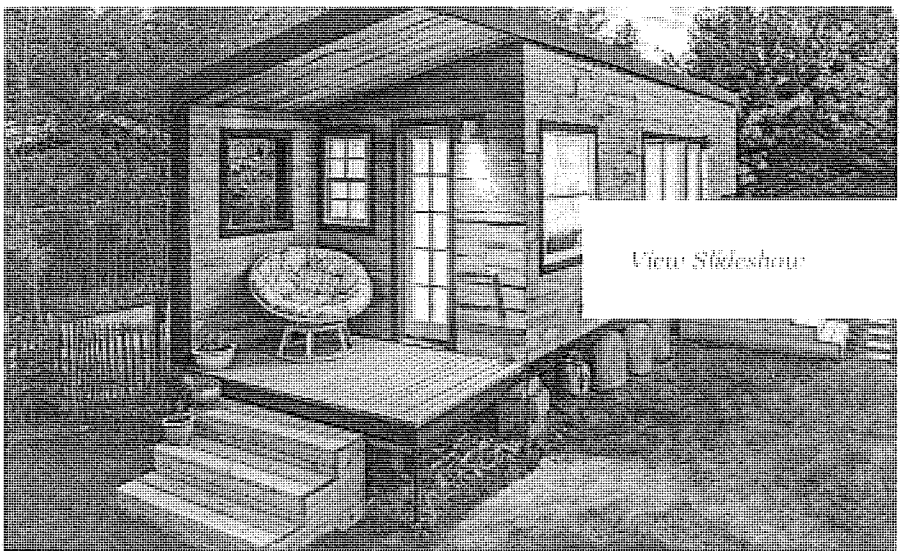

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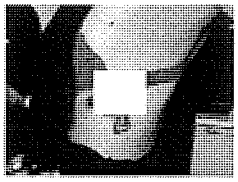

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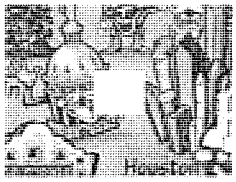

Crazy Town: 3 Wacky Stories From Texas

COMMENTS

CONSPIRACY

24 Hard Facts About 9/11 That Cannot Be Debunked

By DNA on August 13, 2013

9/11 has been one of the biggest events in recent history that sparked a mass awakening across the world. There has been much debate as to how it happened, who is responsible and why. To this day about 1/3 of americans do not believe the official story. In other areas of the world as much as 90% of the country does not believe the official story.

Here is a list of 24 facts that cannot be debunked about 9/11.

1) Nano Thermite was found in the dust at Ground Zero. Peer reviewed in the Bentham Open Chemical Physics Journal. 'Niels Harrit', 'Thermite Bentham', "The great thermate debate" Jon Cole, 'Iron rich spheres' Steven Jones, 'Limited Metallurgical Examination (FEMA C-13, Appendix C-6)'. 'Nano Tubes'

2) 1700+ Engineers and Architects support a real independent 9/11 investigation. Richard Gage, Founder. 'Explosive Evidence', 'Blueprint for Truth', 'AE911′, 'Toronto Hearings', 'Kevin Ryan'.

3) The total collapse of WTC 7 in 6.5 seconds at free fall acceleration (NIST admits 2.25

seconds). Larry Silverstein used the term “Pull it”. Steel framed high rise buildings have NEVER totally collapsed from fire or structural damage. Builidng 7 was not hit by a plane. ‘Building 7′, ‘WTC 7′.

4) Dick Cheney was in command of NORAD on 9/11 while running war games. ‘Stand down order’. “Of course the orders still stand, have you heard anything to the contrary?”. Norman Minetta testimony. “Gave order to shootdown Flight 93.”, ‘NORAD Drills’.

5) 6 out of the 10 Commissioners believe the 9/11 Commission report was “Setup to fail” Co-Chairs Hamilton and Kean, “It was a 30 year conspiracy”, “The whitehouse has played cover up”, ‘Max Cleland resigned’, ‘John Farmer’.

6) FBI confiscated 84/85 Videos from the Pentagon. ‘Moussaoui trial’ revealed these videos. Released Pentagon Security Camera (FOIA) does not show a 757 and is clearly Missing a frame. ‘Sheraton Hotel’, “Double tree’, ‘Citgo”.

7) Osama Bin Laden was NOT wanted by the FBI for the 9/11 attacks. “No hard evidence connecting Bin Laden to 9/11.” CIA created, trained and funded “Al Qaeda/Taliban” during the Mujahideen. OBL was a CIA asset named ‘Tim Osman’. OBL Reported dead in Dec 2001 (FOX).

8)100′s of Firefighters and witness testimony to BOMBS/EXPLOSIONS ignored by the 9/11 Commission Report. 9/11 Commission Report bars 503 1st responder eyewitnesses. “Explosions in the lobby and sub levels”, ‘Firefighter explosions’, ‘Barry Jennings’, ‘William Rodriguez’.

9) 100′s of firefighters and witness testimony to MOLTEN METAL ignored by the Commission report. “Like you’re in a foundry”, “NIST’s John Gross denies the existence of Molten Metal”, ‘Swiss Cheese’, “As of 21 days after the attack, the fires were still burning and molten steel was still running.” Leslie Robertson’.

10) ’5 Dancing Israeli’s’ arrested in ‘Mossad Truck Bombs’ on 9/11 that stated “We were there to document the event.” ‘Urban Moving Systems’ front company, ‘Dominic Suter’. “$498,750 Business loan (June 2001)”. “Officer DeCarlo’, ‘Art Students’, ‘Israeli Spying’.

11) On September 10th, 2001. Rumsfeld reported $2.3 TRILLION missing from the Pentagon. ‘Dov Zakheim’ Pentagon Comptroller. Former VP of ‘Systems Planning Corporation’ (Flight Termination System). Signatore of PNAC document.

12) 220+ Senior Military, Intelligence Service, Law Enforcement, and Government Officials question the official story. ’9/11 Whistleblowers’, ‘Patriots for 9/11′. ‘Robert Bowman’, ‘Sibel Edmonds’, ‘Albert Stubblebine’, ‘Wesley Clark’, ‘Mark Dayton’, ‘Alan Sabrosky’, ‘Cyntha McKinney’, ‘Jesse Ventura’, ‘Kurt Sonnenfeld’. “patriotsquestion911.com”

13) Towers were built to withstand a Boeing jet(s). “I designed it for a 707 to hit it”, Leslie Robertson, WTC structural engineer. “Could probably sustain multiple impacts of jetliners”, “like a pencil puncturing screen netting” Frank De Martini, deceased Manager of WTC Construction & Project Management. “As far as a plane knocking a building over, that would not happen.” Charlie Thornton, Structural Engineer.

14) History of American False Flag attacks. ‘USS Liberty’, ‘Gulf of Tonkin’, ‘Operation Northwoods’, ‘OKC Bombing (Murrah Building)’, ’1993 WTC attacks’. ‘Patrick Clawson’. Project for the New American Century (PNAC) needed “a New Pearl Harbor”, “Rebuilding America’s Defenses”. 9/11 Achieved those goals.

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15) BBC correspondent Jane Standley reported the collapse of WTC 7 (Soloman Brothers building) 20 minutes before it happened. CNN/FOX/MSNBC also had early reports. 'BBC wtc 7', 'Jane Standley', Ashleigh Banfield'.

16) "Flight 93" debris was spread out over many miles. Cheney admits to giving the order to shootdown 93. "shot down the plane over Pennsylvania" Rumsfeld, "nothing that you could distinguish that a plane had crashed there" 'Chris Konicki. "Not a drop of blood" Coroner Wallace Miller. "there was no plane." Mayor Ernie Stull.

17) Bush hesitated for 441 days before starting the 911 Commission. 'Jersey Girls'. 'Phil Zelikow' already wrote the outline before the commission began. Steel shipped over seas. Obstruction of justice. JFK and Pearl Harbor commissions were started within 7 days.

18) The 911 commission was given extremely limited funds. $15 million was given to investigate 9/11. (Over $60 Million was spent investigating Clintons' affairs with Monica).

19) Bush said he watched the first plane crash into the North tower on TV before entering the classroom. "The TV was obviously on." Was informed about the second impact while reading 'My Pet Goat' to the children. Remained for at least 8 more minutes while America was under "attack".

20) The PATRIOT ACT was written before 9/11. Signed into law October 26th, 2001.

21) Marvin Bush was director of Stratasec (Securacom, 'KuAm') which was in charge of security of the WTC, United Airlines and Dulles International Airport. All three were breached on 9/11. ICTS was another company that provided security at the airports. 'Wirt Walker', 'Ezra Harel', 'ICTS", 'WTC power downs'.

22) "Who killed John O'Neil?". Former FBI task force agent investigating Al Qaeda/Bin Laden. Transferred by Kroll Corporation to head the security just before 9/11. John O'Neil died in the Towers. 'Jerome Hauer' 'Jules Kroll'.

23) Insider trading based upon foreknowledge. 'Put Options.' Never identified insiders made millions. 'United and American Airlines' 'Raytheon.'

24) At least 7 of the 19 listed highjackers are still alive (BBC). No video footage of 19 highjackers or passengers boarding the 4 planes. Pilots of the 4 planes never squawked the highjacking code. 'Alive highjackers', 'ACARS', 'Pilots for 9/11 Truth'.

WTC 7 (The Smoking Gun)

http://rememberbuilding7.org/

Building 7 was a 47-story skyscraper and was part of the World Trade Center complex. Built in 1984, it would have been the tallest high-rise in 33 states in the United States. It collapsed at 5:20 pm on September 11, 2001 in 6.5 Seconds at free fall acceleration. It was not hit by an airplane and suffered minimal damage compared to other buildings much closer to the Twin Towers.

Source

LEAVE COMMENTS

474 Comments

474 comments

ENCLOSURE TWO

Petition for Judicial Complaint No. DC-14-90001

ENCLOSURE
TWO

1

NO.
DC-14-90001

LUCAS WHITMAN POMEROY
528 HUDSON COURT
DAVIS, CA 95616
LWPOMEROY@YAHOO.COM
530.219.7595

April 9, 2014

Office of the Circuit Executive
E. Barrett Prettyman U.S. Courthouse
333 Constitution Avenue, N.W.
Washington, D.C. 20001

Regarding: Petition for Judicial Complaint No. DC-14-90001

Dear Judicial Council:

I hereby petition the Judicial Council for review of the above referenced complaint and have developed the following response in order that the Judicial Council may justify inquiring into this situation, and provide remedies as discussed.

The reviewing judge based his dismissal on Rules for Judicial-Conduct and Judicial-Disability Proceeding 11(c)(1)(D), that the complaint "is based on allegations lacking sufficient evidence to raise an inference that judicial misconduct has occurred." As I read Rule 18, the reviewing judge did not investigate this matter and is of the opinion that my allegations are baseless, "lacking sufficient evidence." Due to the seriousness of the allegations and that the allegations are qualified with extensive background and knowledge (that could not have been found elsewhere), in addition to my direct contact with Parsons, a Top Secret contractor, I would think it prudent to at least interview people and ask me for more information and contacts that would supply related information. People are suffering because of this problem and FISC's disrespect for human life, which should be considered when evaluating the validity of investigating this complaint. This calls into question the sanity of the FISC and Mr. Walton, as I suggested in my original complaint (Exhibit 1).

Rules for Judicial-Conduct and Judicial-Disability Proceeding 3(h)(2) states "cognizable misconduct is conduct occurring outside the performance of official duties if the conduct might have a prejudicial effect on the administration of the business of the courts, including a substantial and widespread lowering of public confidence in the courts among reasonable people." I am a reasonable person. So are Representative Mike Rogers and Senator Dianne Feinstein, both of which you should contact and have obviously lost confidence in the courts, as any news story will tell you. I suspect due to the specific actions of Mr. Walton, many other people have lost confidence in FISC, Mr. Walton and the courts in general.

Rules for Judicial-Conduct and Judicial-Disability Proceeding 3(e) states, "disability is a temporary or permanent condition rendering a judge unable to discharge the duties of the particular judicial office. Examples of disability include substance abuse, the inability to stay awake during court proceedings, or a severe impairment of cognitive abilities." As stated in the original complaint and above, I believe Mr. Walton and others are sociopathic. This could be determined by a number of personality tests.

My complaint is the truth and what it states is fact. It can be verified (see Exhibit 1). I am happy to be put on a lie-detector and provide you with contacts that are aware of the situation. I sincerely hope that the Judicial Council will investigate this situation. For your review, I have enclosed several technical reports that discuss the science behind my accusations (Exhibit 2). I have also enclosed other documents that relate to the complaint and are being submitted for review by the Judicial Council:

Armed with Science: The Official U.S. Defense Department Science Blog, Mind Justice: A Synopsis of Projects and Progress, a University of Washington Study excerpt, company information on Neurosky, an article in SFGate titled "Complex Brain Imaging is Making Waves in Court" and several letters to decision makers from myself (Exhibit 3).

I would like to see FISC remedy this situation by obtaining signatures for the enclosed contract (Exhibit 4). Under contract item 14.1: Development of Remedy Corporation and Distribution of Funds, it states, "Within a year of execution of this contract a remedy corporation, Buckle & Bernard Agency Developers, LLC will be set up by the Supplier for the purpose of providing financial restitution and other services." This is to ensure restitution is guaranteed for these people. Additionally, I would like all necessary licenses and any developed legislation to protect myself from the government(s). Lastly, I would like to see the Judicial Council "take remedial action to ensure the effective and expeditious administration of the business of the courts, including: censuring or reprimanding the subject judge, either by private communication or by public announcement." I'm suggesting that Mr. Walton and any FISC members, etc. be reprimanded by signing an agreement that states if they do not stop participating in this Special Access Program and bring it to a conclusion, they will be prosecuted (for example agreement see Exhibit 4).

The Justice Department is guilty of breaking the Electronic Communications Privacy Act, as amended in Title III of the Omnibus Crime Control and Safe Streets Act of 1968 (the Wiretap Statute), and has illegally tapped information from myself and others through the use of electromagnetic and ultrasound technology. Electronic communications means any transfer of signs, signals, writing, images, sounds, data, or intelligence of any nature transmitted in whole or in part by a wire, radio, electromagnetic, photoelectronic or photooptical system. The Justice Department has private information about me that it has illegally acquired and therefore is guilty not only of torture, but is guilty of intruding upon my privacy even after the DOJ determined I was neither a threat nor a criminal, and they continue to do so. The simple fact that all this is classified does not make it legal, moral or ethical.

You have seen some recent events in the world that are directly related to this complaint. It is my belief that supplying me with some "guarantees," (as discussed in the original complaint and above) many problems could be avoided in the future and this could be handled appropriately, by competent people and agencies.

Finally, I have been accused of attempting to "hold the government hostage" for my own benefit. I guarantee your crazy Aunt Betty would disagree. SHe knows. For you to think that this technology could not be used against you, the Judicial Council, is both ignorant and scary. Only through proper legislation and action will this problem be solved.

Sincerely,

Lucas W. Pomeroy, MBA, B.S. Forestry & Natural Resource Management

Enclosures: Exhibit 1: Original Complaint and Chief Judge Order, Exhibit 2: Technical Reports, Exhibit 3: Other Information, Exhibit 4: Documents: Contract and Example Cease and Desist Agreement

EXHIBIT 1

Original Complaint & Chief Judge Order

"People involved in this SAP (Special Access Program) and situation are abusing their power, are fraudulent and display corrupt characteristics. This technology and situation has major implications for the future of humankind. It is my hope to work within the system and laws to stop this gross torture of humans and bring this SAP to a conclusion and move forward to the future."

EXHIBIT 1

JUDICIAL COUNCIL OF THE DISTRICT OF COLUMBIA CIRCUIT
COMPLAINT OF JUDICIAL MISCONDUCT OR DISABILITY

E. Barrett Prettyman U.S. Courthouse
333 Constitution Avenue, N.W.
Washington, D.C. 20001-2866
202-216-7340

This form should be completed and mailed to the above address to the attention of the "Circuit Executive". The envelope should be marked "JUDICIAL MISCONDUCT COMPLAINT" or "JUDICIAL DISABILITY COMPLAINT". Do not put the name of the judge or magistrate judge on the envelope.

The "Rules for Judicial-Conduct and Judicial-Disability Proceedings", adopted by the Judicial Conference of the United States, contain information on what to include in a complaint (Rule 6), where to file a complaint (Rule 7), and other important matters. Your complaint (this form and the statement of facts) should be typewritten and must be legible.

Number of copies. If the complaint is about a single judge of the court of appeals, submit three copies of this form, the statement of facts, and any documents. If it is about a single district court judge, magistrate judge, or bankruptcy judge, four copies must be filed. If the complaint is about more than one judge, enough copies must be filed to provide one for the clerk of the court, one for the chief judge of the circuit, one for each judge complained about, and one for the Chief Judge of the District Court if the subject judge is a district judge.

1. Complainant's Name: Lucas Whitman Pomeroy

   Address: 528 Hudson Court, Davis, CA 95616

   Telephone: (530) 219 - 7,595

2. Judge or Magistrate Judge complained about:

   Name: Reggie B. Walton

   Court: United States District Judge for the District of Columbia and FISC

3. Does this complaint concern the behavior of the judge(s) or magistrate judge(s) in a particular lawsuit or lawsuits? ○ Yes ◉ No

   If "yes" give the following information about each lawsuit (use reverse side if more than one):

   Court: _____

   Case number: _____

   Are (were) you a party or lawyer in the lawsuit?

   ○ Party ○ Lawyer ○ Neither

If a party, give the following information:

Lawyer's Name: _____

Address: _____

Telephone: (___) ___ - ____

Docket number(s) of any appeals of above case(s) to the Court of Appeals, D.C. Circuit:

_____

4. Have you filed any lawsuits against the judge or magistrate judge?

○ Yes ◉ No

If "yes" give the following information about each lawsuit (use the reverse side if more than one)

Court: _____

Case number: _____

Present status of lawsuit: _____

Your lawyer's name: _____

Address: _____

Telephone: (___) ___ - ____

Court to which any appeal has been taken in the lawsuit against the judge: _____

Docket number of the appeal: _____

Present status of the appeal: _____

5. **Brief Statement of Facts.** Using the next page of this form and up to four additional double-sided pages (8.5 x 11") as necessary, submit a brief statement of the specific facts on which the claim of judicial misconduct or disability is based. Include what happened, when and where it happened, and any information that would help an investigator check the facts. If the complaint alleges judicial disability, also include any additional facts that form the basis of that allegation. See Rule 6 (a) for further information on what to include in your statement of facts.

Declaration and Signature:

☒ I declare under penalty of perjury that the statements made in this complaint are true and correct to the best of my knowledge.

Signature: _____ Date: _____

This complaint is filed against United States Foreign Intelligence Surveillance Court Judge Reggie B. Walton. Some of the information contained in this complaint is classified. Therefore, this complaint must be handled in a classified arena such as FISC to determine the facts. Because this information lays claims against Mr. Walton and other highly visible political, military, intelligence and industry people, it may be self-defeating to handle this in the view of the public, for the good of the public. It puts undue pressures on people, yet I am more than happy to bring this before the entire world if necessary. It may be necessary to provide me with guarantees prior to opening hearings or investigations on this matter. I have supplied the Federal Government with an unclassified contract that has not been signed. That contract will supply me with some guarantees. I have also requested several licenses that will additionally help. Due to the nature of the situation, I will not sign any non-disclosure documents at this time. If providing me with a classification is necessary to deal with the situation, I will review the paperwork at that time and make a decision. With that said, Mr. Walton and the people I previously alluded to, are guilty of misconduct in their respective positions and have proven that they are a threat to themselves and to others that associate with them. The following will provide the information necessary for you to take action against Mr. Walton and the other perpetrators of injustice, torture and corruption.

As some background, I previously worked for Parsons (a major federal contractor) and was involved in top-level technology at the company. My first day on the job was September 10, 2001. We all know what happened the next day. After some disagreements over some issues, I left Parsons but have continued to be involved in a Top Secret Special Access Program (SAP) based on psychotronics, sometimes called neuroweapons. As you may know, psychotronics is basically telepathic communication via the brain, helped by technology. We have recently seen some applications of this technology in the commercial sector, such as robotic manipulation via the brain. Likewise, Mr. Obama's recent announcement to "map" the brain is another example, which has already been accomplished. Each word in a language can be mapped to a specific and unique region of the brain. Once each word has been mapped to the individual brain, algorithms and computers monitoring the brain can interpret the brain's regions that "light up" into the actual thoughts and language of the subject. The four following websites illustrate this technology and some of the potential hazards:

http://science.dodlive.mil/2010/09/01/remote-control-of-brain-activity-using-ultrasound
http://kplu.org/post/uw-researchers-use-brain-one-control-body-another
http://neurotrek.com/applications/
http://www.mindjustice.org/#2

I know this technology is being used to torture many humans and I want to stop it from occurring, as noted in Congressman Dennis Kucinich's HR 2977 and Federal Assembly, Parliament of the Russian Federation, Governmental Duma, Committee on Safety, Resolution from the 30th of November of the year 2000, No. 28/3. Mr. Walton and others are aware of this blatant disrespect for human life, which in normal human psychological culture and conditions, would be determined to be sociopathic bordering on psychopathic, thus determining that Mr. Walton and the others are a danger to others through their actions of involvement in a massive government torture and intelligence gathering program, which is the SAP I previously mentioned. In discharge of their duties, they have put enormous physical and mental pain upon millions of innocent people. (continued)

(continued from previous page)

Not only are Mr. Walton and others sociopathic, they are also guilty of, at a minimum, in adhering to their enemies, giving them aid and comfort. I do not take accusing these people of high treason lightly. The following makes accusations which could be corroborated in a classified setting.

In most parts of the world people understand that 911 was an inside job, a false flag operation set in motion as a justification for the SAP I previously mentioned. The Bush Administration defined 911 as an act of war against the United States of American and did what we now know was a somewhat questionable entry into the Middle East. As an act of war, any American personnel involved in that act of war, would be determined a high traitor, as spelled out in Article 3, Section 3 of the United States Constitution. It is my contention that Mr. Walton and the others are aware of this and have not brought charges against the people who are actually responsible for 911, therefore guilty of adhering to their enemies, giving them aid and comfort.

People involved in this SAP and situation are abusing their power, are fraudulent and display corrupt characteristics. This technology and situation has major implications for the future of humankind. It is my hope to work within the system and laws to stop this gross torture of humans and bring this SAP to a conclusion and move forward to the future.

It would be my pleasure to further discuss this with you. I look forward to the future and the possibility to work with you on this problem and opportunity. I request consultation with your personnel who have the necessary requirements to discuss this without jeopardizing myself, the Federal Government and/or the population at large. In addition, I am requesting FBI (or other capable agency) protection from retaliation against me for my services to the United States of America.

In closing, I have been more than understandable regarding this problem and have given the Federal Government every opportunity I could think of to resolve this problem, to be only met with ignorance, arrogance and stonewalling. The system and the people in the system are corrupt. The system can only change by people changing it. I am trying to change the people so that they will change the system. The question is, do I have the time?

Lucas W. Pomeroy

The Judicial Council

FOR THE DISTRICT OF COLUMBIA CIRCUIT

In the Matter of **Judicial Council Complaint No. DC-14-90001**

A Charge of Judicial Misconduct or Disability

Before: GARLAND, Chief Judge of the Circuit

ORDER

Upon consideration of the complaint herein, filed against a judge of the United States District Court for the District of Columbia, it is

ORDERED that the complaint be dismissed for the reasons stated in the attached Memorandum. *See* 28 U.S.C. § 352(b)(1)(A)(iii); JUD. CONF. U.S., RULES FOR JUDICIAL-CONDUCT AND JUDICIAL-DISABILITY PROCEEDINGS 11(c)(1)(D).

The Clerk is directed to send copies of this Order and accompanying Memorandum to the complainant, the subject judge, and the Judicial Conference Committee on Judicial Conduct and Disability. *See* 28 U.S.C. § 352(b); JUD. CONF. U.S., RULES FOR JUDICIAL-CONDUCT AND JUDICIAL-DISABILITY PROCEEDINGS 11(g)(2).

Merrick B. Garland, Chief Judge
District of Columbia Circuit

Date: 3-31-14

MEMORANDUM

The complainant alleges that a judge of the United States District Court for the District of Columbia engaged in conduct prejudicial to the effective and expeditious administration of the business of the courts. For the following reasons, the allegations do not warrant action against the subject judge.

The complainant alleges that the judge "and other highly visible political, military, intelligence and industry people" are "a danger to others through their actions of involvement in a massive government torture and intelligence gathering program" involving "psychotronics," which "is basically telepathic communication via the brain, helped by technology." The complainant further asserts that "[n]ot only are [the judge] and others sociopathic, they are also guilty of, at a minimum, . . . adhering to their enemies, giving them aid and comfort." In particular, the complainant alleges "that 911 [sic] was an inside job," that the judge "and the others are aware of this and have not brought charges against the people who are actually responsible for 911," and that they are "therefore guilty of adhering to their enemies."

The Rules for Judicial-Conduct Proceedings require a chief judge to dismiss a complaint that "is based on allegations lacking sufficient evidence to raise an inference that judicial misconduct has occurred." Jud. Conf. U.S., Rules for Judicial-Conduct and Judicial-Disability Proceedings 11(c)(1)(D); *see* 28 U.S.C. § 352(b)(1)(A)(iii). Because

the complaint contains no evidence to support the above-described allegations, it must therefore be dismissed.[1]

---

[1] Pursuant to 28 U.S.C. § 352(c) and JUD. CONF. U.S., RULES FOR JUDICIAL-CONDUCT AND JUDICIAL -DISABILITY PROCEEDINGS 18(a), the complainant may file a petition for review by the Judicial Council for the District of Columbia Circuit. Any petition must be filed in the Office of the Clerk of the Court of Appeals within 35 days of the date of the Clerk's letter transmitting the dismissal Order and this Memorandum. *Id.* R. 18(b).

EXHIBIT 2

Technical Reports

"As a tool for modulating neuronal function, US (ultrasound) has been studied and considered across a range of uses from thermal ablation of nervous tissues to its ability to produce sensory perceptions."

"Transcranial ultrasonography of the basilar artery has been shown to trigger auditory sensations in human subjects [58]. Other studies have reported similar observations in animals during delivery of transcranial US and at least one underlying mechanism is thought to involve the direct stimulation of auditory nerve fibers by US [10]. Collectively, these observations demonstrate transcranial US is capable of evoking sensory stimuli even in humans."

EXHIBIT 2

nature neuroscience

Transcranial focused ultrasound modulates the activity of primary somatosensory cortex in humans

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Improved methods of noninvasively modulating human brain function are needed. Here we probed the influence of transcranial focused ultrasound (tFUS) targeted to the human primary somatosensory cortex (S1) on sensory-evoked brain activity and sensory discrimination abilities. The lateral and axial spatial resolution of the tFUS beam implemented were 4.9 mm and 18 mm, respectively. Electroencephalographic recordings showed that tFUS significantly attenuated the amplitudes of somatosensory evoked potentials elicited by median nerve stimulation. We also found that tFUS significantly modulated the spectral content of sensory-evoked brain oscillations. The changes produced by tFUS on sensory-evoked brain activity were abolished when the acoustic beam was focused 1 cm anterior or posterior to S1. Behavioral investigations showed that tFUS targeted to S1 enhanced performance on sensory discrimination tasks without affecting task attention or response bias. We conclude that tFUS can be used to focally modulate human cortical function.

Current noninvasive neuromodulation methods, such as transcranial magnetic stimulation (TMS) and transcranial direct current stimulation, offer low spatial resolutions. These methods typically produce electric fields having length scales on the order of several centimeters, which span anatomically and functionally distinct human brain circuits[1,2]. As a result, current transcranial approaches often modulate activity not only in the intended target but also in surrounding brain circuits[1,3]. Therefore, improved approaches to the transcranial modulation of human brain circuit activity are sought to support global brain mapping efforts, as well as to advance diagnostics and therapies in neuroscience. In the present study, we investigated the potential use of pulsed ultrasound (US) for focally modulating cortical function in humans.

Studies examining the direct effects of US on neuronal activity date back to 1929, when US was first shown to excite nerve fibers in isolated turtle and frog muscle preparations[4]. Evidence accumulated since then has shown that US can directly modulate neuronal activity in peripheral nerves[5,6], elicit action potentials in hippocampal slices[7,8] and stimulate retina[9]. Further, US can noninvasively stimulate the hippocampus and motor cortex of intact mice[10,11], modulate monosynaptic and polysynaptic spinal reflexes in cats[12] and disrupt seizure activity in cats[13], rats[14] and mice[15]. Additional evidence from animal models has demonstrated that US can elicit functional magnetic resonance imaging blood oxygen–level dependent contrast signals in the visual and motor cortices of rabbits[16], reversibly suppress the amplitudes of visual evoked potentials in both cats[17] and rabbits[16], and functionally modulate neuronal activity in the frontal eye fields of awake, behaving monkeys[18]. At low intensities for short exposure times, tissue heating does not occur, so the mechanisms underlying the effects of US on neuronal activity are thought to partially stem from mechanical pressure effects of US on cellular membranes and ion channels[5,10,16,19,20]. These mechanical actions of US have not been reported to cause tissue damage when used to modulate neuronal activity[5,9–11,15,16,19].

Despite observations in different animal models, it has remained untested whether US can focally modulate the activity of intact human brain circuits. Therefore, we aimed to determine whether tFUS is capable of functionally modulating brain activity in the human primary somatosensory cortex. Our findings indicate tFUS can focally modulate sensory evoked brain activity and cortical function in humans. These observations may help advance the development of enhanced noninvasive neuromodulation strategies.

RESULTS

Acoustic beam properties of tFUS

The optimal acoustic frequencies for the transcranial transmission and brain absorption of US are known to be <0.65 MHz (refs. 21,22). We used 0.5-MHz US on the basis of previous observations that it can modulate mammalian brain activity[10,11]. First we quantified acoustic pressure fields emitted from a single-element focused ultrasound (FUS) transducer having a center frequency of 0.5 MHz, a diameter of 30 mm and a focal length of 30 mm. Using a calibrated hydrophone mounted on a motorized, three-axis stage, we recorded acoustic pressure fields transmitted from the FUS transducer into the free space of an acoustic test tank, as well as through hydrated fragments of human cranium (Fig. 1; see Online Methods). Our measurements revealed that when FUS was transmitted through the skull the spatial-peak pulse-average intensity (I_{SPPA}) dropped by approximately fourfold (1/4.05), corresponding to a −6.07 dB insertion loss with

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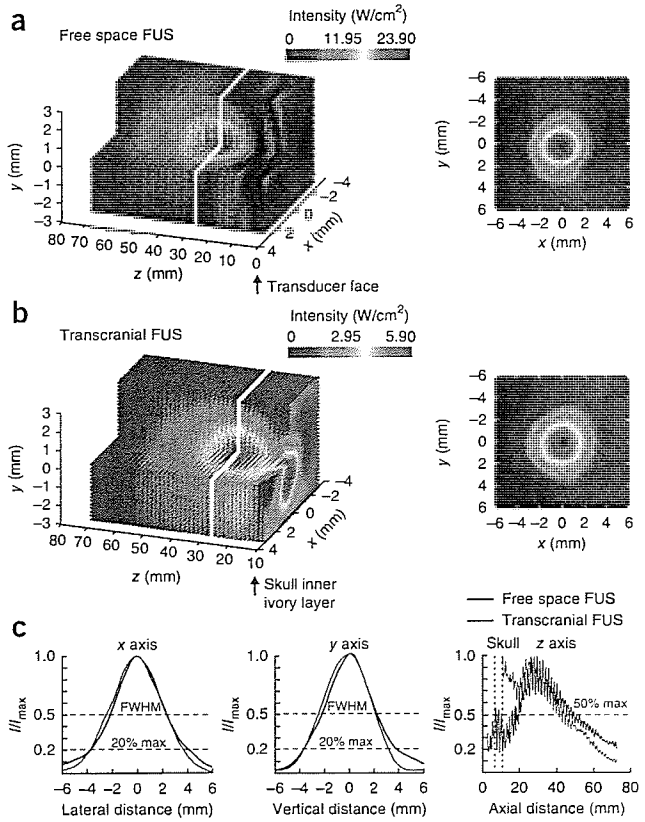

Figure 1 Ultrasound can be focused through human skull bone. (a,b) Acoustic intensity fields emitted from a 0.5-MHz FUS transducer measured in free space (no skull, a) and after transcranial transmission through hydrated human cranial bone (tFUS, b). The white lines on the three-dimensional acoustic intensity maps (left) indicate the focal plane where the spatial peak pulse average intensity of the acoustic field was measured. Acoustic beam cross-sections of these focal planes are illustrated at right. (c) Line plots illustrate the lateral (*x*; left) and vertical (*y*; middle) peak normalized acoustic intensity profiles for the acoustic beam in the focal plane of 0.5-MHz FUS transmitted into free space (no skull; black) and through human cranial bone (red). Also illustrated are line plots (right) showing the axial (*z*) peak normalized intensity profiles of the FUS field for both the free space and transcranial conditions.

our skull sample (**Fig. 1a**,b). This loss varied slightly across acoustic powers (free space powers and pressures ranging from I_{SPPA} = 0.12 W/cm^2 and 0.12 MPa peak-to-peak pressure to I_{SPPA} = 50 W/cm^2 and 2.5 MPa peak-to-peak pressure, respectively) from a 3.7- to 4.1-fold drop in intensity when transmitting 0.5-MHz FUS through human cranial bone.

We characterized the three-dimensional shape of FUS acoustic fields in free space and after transcranial transmission (**Supplementary Table 1**). Transmitting FUS through human cranial bone caused an approximately 10% loss in lateral and vertical spatial resolution of the acoustic beam, estimated by the intensity full width at half maximum (FWHM; **Fig. 1c**). The lateral (*x*) and vertical (*y*) dimensions of FUS beam cross-sections measured at the intensity FWHM were 4.33 and 4.48 mm in the free space condition and 4.56 and 4.89 mm after transcranial transmission (**Fig. 1c**). We also characterized the acoustic field in the axial direction along the *z* axis, perpendicular to the transducer face and skull, from the spatial-peak intensity maximum to 50% and 20% maximum of intensity (**Supplementary Table 1**). The FUS intensity half width of the half maximum (HWHM) was 20.4 mm in the free space condition and 18.0 mm after transcranial transmission (**Fig. 1c**). Under these conditions, transmission of 0.5-MHz FUS through the skull led to a reduced pressure depth-of-field and an approximately 12% increase in the axial resolution. This natural focusing may be best described as a nonlinear effect that causes a cone of FUS to rotate back toward the skull insertion point, creating a more compact pressure ellipsoid–shaped acoustic field (**Fig. 1c**). Thus, the skull is not an obstacle for transcranial focusing of US and may actually exert an acoustic lensing effect to enhance spatial resolution under certain conditions.

Targeting tFUS to the primary sensory cortex

We targeted left S1 by transmitting tFUS beams into cortex from a transducer positioned perpendicular to the scalp at electroencephalographic (EEG) electrode site CP3 (**Supplementary Fig. 1a**). We visualized tFUS beam locations in the brain using realistic models of human heads generated using a finite element method (FEM). Briefly, the gray matter, white matter, cerebrospinal fluid, skin and skull were segmented from magnetic resonance images and, on the basis of the binary tissue masks, a three-dimensional FEM model of the head containing approximately 1.7 million tetrahedral elements was created (see Online Methods).

When targeting S1, the tFUS beam displayed a first prominent maximum of acoustic field strength in the brain at the top of the gyral crown in the postcentral gyrus (**Fig. 2a**). The tFUS field produced a second maximum of field strength in the posterior wall of the central sulcus at a depth of approximately 2 cm (**Fig. 2b**,c). This bimodal acoustic intensity distribution was due to the acoustic wave behavior arising from transcranial transmission, as observed during quantitative field mapping of tFUS beams (**Fig. 1b**,c). We observed the acoustic intensity field to drop to approximately 50% of its maximum in brain regions 2 mm anterior or posterior from the beam center (**Fig. 2c**).

tFUS modulates sensory-evoked brain activity

In a within-subjects design, we studied the influence of tFUS on short-latency and late-onset evoked brain activity by examining the peak-to-peak amplitudes of somatosensory evoked potentials (SEPs) and the spectral content of evoked EEG activity elicited by right median nerve (MN) stimulation. We targeted 0.5-MHz tFUS beams to the crown and posterior wall of the left central sulcus (S1) in human participants (N = 10) by placing the FUS transducer at the 10-20 EEG electrode site CP3 (**Supplementary Fig. 1a**). EEG activity was recorded from four electrodes surrounding CP3 placed at C3, CP1, CP5 and P3. The tFUS stimulus consisted of individual pulses having a pulse duration of 360 μs repeated at 1 kHz for 500 ms. Transmission of the tFUS stimulus began 100 ms before MN stimulation (**Supplementary Fig. 1b**,c; see Online Methods). The sham condition was identical to the tFUS treatment except that the geometrically symmetrical inactive face (rather than the active face) of the transducer contacted the scalp to control for a chirping sound produced by the transducer during its excitation. Volunteers did not report any thermal or mechanical sensations due to tFUS transmission through the scalp. Similarly, there were no reports of perceptual differences between the sham and tFUS conditions.

The SEP produced by MN stimulation during EEG recordings has been well studied. Its components are named according to their negative (N) or positive (P) polarities and latencies (in ms) as N20, P27, N33, P50, N70, P100 and N140. The N20 component of the MN-evoked SEP has been shown to represent sensory input from the

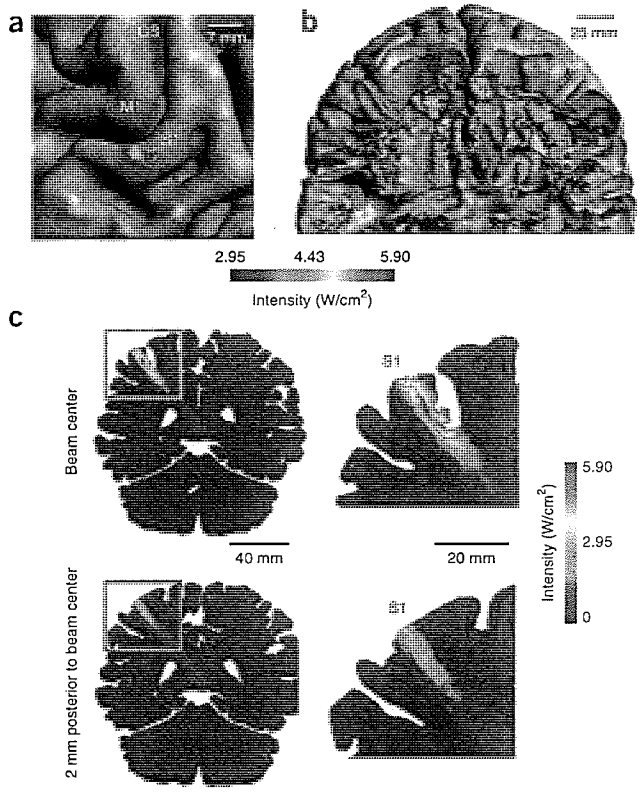

Figure 2 tFUS can be targeted to spatially discrete regions of human cortex. (a,b) Top-down (a) and coronal cutaway view (b) showing the acoustic intensity field of the tFUS beam projected from EEG site CP3 into a realistic FEM model of the brain derived from whole-head structural magnetic resonance images. Projection of the tFUS acoustic field illustrates the targeting of primary somatosensory cortex (S1) with reference to the primary motor cortex (M1) and the central sulcus (CS). (c) Coronal magnetic resonance slices showing projections of the measured tFUS fields from EEG electrode site CP3, further illustrating the spatial specificity of 0.5-MHz tFUS in the crown of the postcentral gyrus (S1) and posterior wall of the central sulcus. Coronal slices are shown along the anterior-posterior axis of the beam corresponding to the center of the beam (top) and 2.0 mm posterior to the beam center (bottom) to show the acoustic intensity drop-off as a function of tFUS beam width.

dorsal column–medial lemniscal pathway by thalamocortical fibers originating in the ventroposterolateral nucleus of the thalamus and terminating in Brodmann area 3b (anterior bank of the postcentral gyrus facing the central sulcus) of S1 (ref. 23). Subsequent slow-onset late potentials with a latency of about 200 ms or later are thought to reflect the ensuing serial processing of somatosensory information from S1 Brodmann area 3b to areas 1 and 2, as well as to higher-level somatosensory processing areas, including posterior parietal cortex (Brodmann areas 5 and 7) and secondary somatosensory cortex, serving different functions in the encoding of stimulus representations[24,25].

We found that C3 most reliably captured both short-latency and late-onset brain activity evoked by MN stimulation. Compared to sham, tFUS elicited a significant reduction in the peak-to-peak amplitude of the short-latency N20–P27 SEP complex recorded at C3 (**Fig. 3** and **Table 1**) and CP1 (sham, $1.22 \pm 0.14\ \mu V$, s.e.m.; tFUS, $0.73 \pm 0.15\ \mu V$; $P = 0.014$; **Fig. 3**). We also observed tFUS to produce a significant reduction in the amplitude of the short-latency N33–P27 SEP complex recorded at C3 (**Fig. 3** and **Table 1**). The reduction in amplitudes of these short-latency SEP components remained stable across the duration of experiments, indicating that there were no cumulative effects of tFUS on brain activity as studied (**Fig. 4**). tFUS also produced significant effects on the amplitudes of the N70–P50 complex recorded at CP5 (sham, $-3.30 \pm 0.65\ \mu V$; tFUS, $-2.85 \pm 0.46\ \mu V$; $P = 0.017$) and P3 (sham, $-0.66 \pm 0.15\ \mu V$; tFUS, $-1.42 \pm 0.23\ \mu V$; $P = 0.010$) (**Fig. 3**). Lastly, the late potential recorded from C3 was significantly attenuated by tFUS (**Fig. 3** and **Table 1**). In summary, we found that tFUS targeted to S1 modulated the amplitudes of both short-latency and late-onset SEP complexes.

Spectral decomposition of EEG provides additional valuable information on ongoing oscillatory dynamics that is regarded as reflecting cortical excitability and information processing in the human brain[26,27]. As such, we performed spectral decomposition on the time epoch of −200 to 500 ms around MN stimulation to further evaluate the effects of tFUS on sensory-evoked brain activity compared to sham treatment. Compared to sham, we found that tFUS significantly ($P < 0.025$) decreased the power of alpha-band (7–12 Hz) and beta-band (13–30 Hz) baseline activity recorded from EEG sites C3 and P3 in the 100 ms following the onset of tFUS transmission before MN stimulation (**Fig. 3**). We also found that tFUS produced a significant ($P < 0.025$) attenuation in the power of short-latency evoked gamma-band (30–55 Hz) activity occurring within 70 ms of MN stimulation (**Fig. 3**). As was also evident to varying degrees across the EEG channels recorded, tFUS significantly modulated the power of late-onset alpha-, beta- and gamma-band activity occurring about 200 ms after MN stimulation or later (**Fig. 3**).

tFUS modulates sensory detection thresholds

We next examined the behavioral effects of tFUS delivered to S1 on sensory detection thresholds using two-point and frequency discrimination tasks (see Online Methods). Briefly, participants ($N = 12$) were required to decide whether they experienced one or two stimuli in response to the application of one or two pins (spaced from 0.3 to 2.8 mm apart in 0.3 mm increments) to the pad of their right index finger for 250 ms at a constant force during sham and tFUS treatments. The presentation of sensory stimuli began 100 ms after the onset of tFUS or sham treatment. In a separate experiment on a different day, 12 subjects (10 of the subjects completed both tasks) were required to decide whether the frequency of the second of two discrete air puff trains (500 ms train duration each, 500 ms inter-stimulus interval) applied to their right index finger was higher than the frequency of the first air puff train. The frequency of the first air puff train remained constant at 100 Hz while the frequency of the second stimulus varied randomly between 100 and 150 Hz in 5-Hz increments. Sham and tFUS conditions were counterbalanced across subjects in each experiment.

Data obtained from the two-point and frequency discrimination tasks were analyzed using signal detection theory[28]. During two-point discrimination catch trials (control trials using a single pin), the percentage of responses correct (sham, 85 ± 5%; tFUS, 84 ± 5%) was not different during tFUS and sham treatment ($z = 0.751$, $P = 0.453$; **Supplementary Fig. 2a**). These values indicate that participants' attention was directed to the task and did not differ between tFUS and sham treatments. A Wilcoxon signed-rank test revealed no difference in criterion values between the tFUS condition and the sham condition ($z = -0.756$, $P = 0.450$; **Supplementary Fig. 2a**). These data indicate tFUS did not affect response bias or influence participants to respond a certain way. We examined discrimination thresholds using the cumulative sensitivity index (d'), where $d' > 1$ was considered

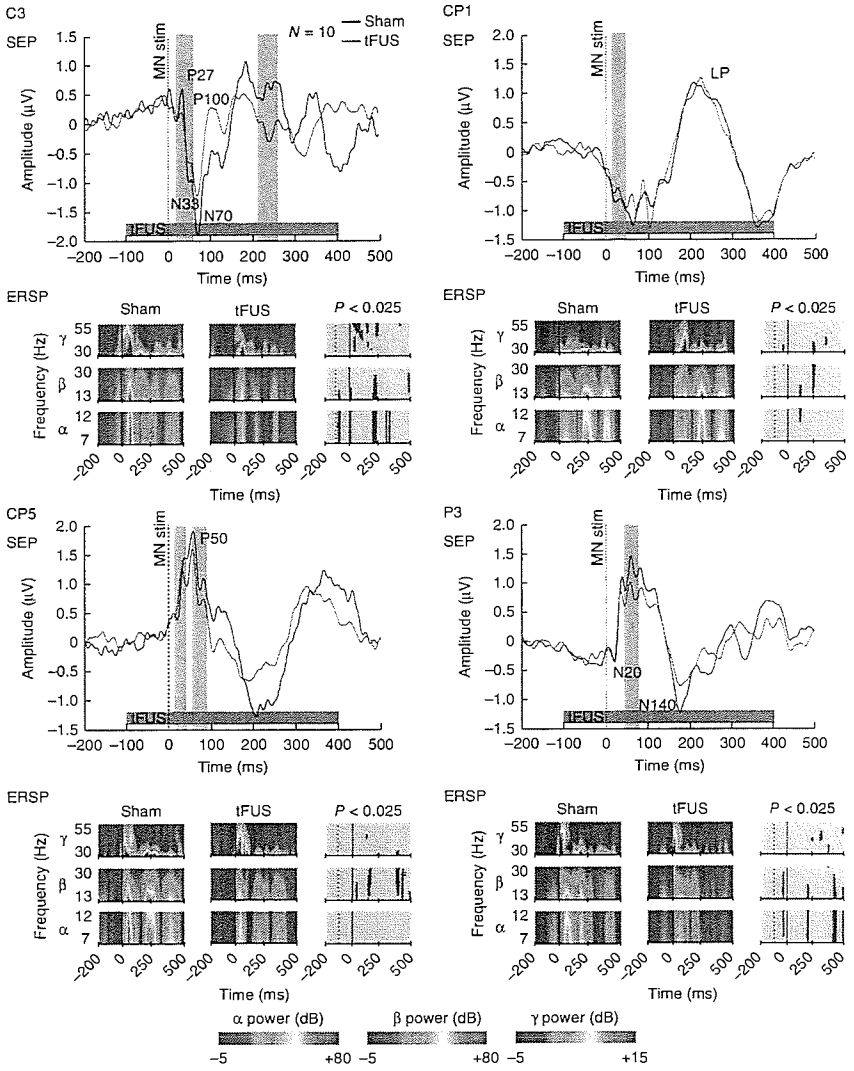

Figure 3 tFUS targeted to human somatosensory cortex modulates sensory-evoked brain activity. Top panels, grand average ($N = 10$) SEP by electrode site (C1, CP1, CP5 and P3) as a result of right median nerve stimulation (MN stim; 100 trials) for sham (black) and tFUS (red) treatment conditions. N20, P27, N33, P50, N70, P100, N140 and late potential components of SEPs are annotated across the different electrode sites. Gray vertical bars indicate regions of significant differences ($P < 0.025$) in the peak-to-peak amplitudes of SEP complexes between sham and tFUS conditions. Bottom, time-frequency plots illustrating the spectral power of evoked brain oscillations in the alpha (7–12 Hz), beta (13–30 Hz) and gamma (30–55 Hz) frequency bands in relation to the onset of tFUS (dashed vertical line) and MN stimulation (solid vertical line) for sham and tFUS treatment conditions. Statistical difference plots are also shown for each frequency band: maroon regions indicate a significant difference ($P < 0.025$) between sham and tFUS treatment conditions. Color scale at the bottom of the figure indicates the power for each frequency band.

the discrimination threshold (**Fig. 5**). A Wilcoxon signed-rank test revealed that volunteers showed significant improvements in their ability to distinguish pins at closer distances during tFUS treatments compared to sham ($z = 2.196$, $P = 0.028$; **Fig. 5a**).

A Wilcoxon signed-rank test revealed that subjects were also significantly better at discriminating small frequency differences between successive air puff trains during tFUS trials compared to sham ($z = 2.102$, $P = 0.036$; **Fig. 5b**). The percentage of responses correct during randomly administered air puff frequency discrimination catch trials (where the air puff trains had equal frequencies) did not differ between tFUS and sham conditions (sham, 80 ± 6%; tFUS, 83 ± 5%; $z = 0.253$, $P = 0.800$; **Supplementary Fig. 2b**), indicating that participant attention did not differ across treatments. Likewise, tFUS did not alter participants' response bias compared to sham as indicated by a Wilcoxon signed-rank test on the criterion values obtained during frequency discrimination testing ($z = -0.203$, $P = 0.840$; **Supplementary Fig. 2b**). Collectively, these data show that tFUS enhanced the somatosensory discrimination abilities of participants as assessed by two-point and frequency discrimination tasks, without affecting response bias or task attention.

Table 1 Mean amplitudes of SEP complexes recorded from C3 when tFUS beam was targeted to S1

	Mean amplitude ± s.e.m. (μV)		
SEP complex	Sham	tFUS	*P* value
P27–N20	0.83 ± 0.15	0.38 ± 0.09	0.011*
N33–P27	−1.66 ± 0.15	−0.99 ± 0.13	0.043*
P50–N33	3.12 ± 0.50	2.72 ± 0.44	0.244
N70–P50	−2.21 ± 0.40	−2.42 ± 0.62	0.783
P100–N70	1.54 ± 0.48	2.66 ± 0.85	0.530
N140–P100	−1.72 ± 0.46	−1.71 ± 0.72	0.715
Late potential	3.78 ± 0.85	2.87 ± 0.85	0.004*

*$P < 0.05$.

tFUS modulation of brain activity is spatially restricted

We next studied the focal specificity of tFUS by analyzing SEP complex amplitudes and the spectral content of EEG activity elicited by MN stimulation within volunteers ($N = 8$) when transducers were placed 1 cm anterior and 1 cm posterior to the CP3 location in a counterbalanced manner. Here we focused on examining the influence of tFUS on EEG activity recorded from electrode C3 because it best captured the early sensory components of SEPs as described above. With respect to targeting, our FEM models showed that moving the FUS transducer 1 cm anterior to CP3 generated an acoustic beam in brain regions located across the central sulcus in the precentral gyrus. Similarly, displacing the transducer 1 cm posterior to CP3 resulted in the acoustic beam being focused in brain regions posterior to the crown of the postcentral gyrus (**Fig. 6a**). This displacement of acoustic beams along the anterior-posterior axis enabled the targeting of non-overlapping and spatially discrete brain regions by tFUS.

Whereas tFUS targeted to the crown and posterior wall of the central sulcus (S1) produced a significant decrease in the amplitude of both short-latency (N20/P27 and P27/N33) and late-onset SEP complexes (**Fig. 3** and **Table 1**), moving the acoustic beam 1 cm anterior or posterior from this site abolished these effects. Specifically, there were no significant differences between the amplitudes of any

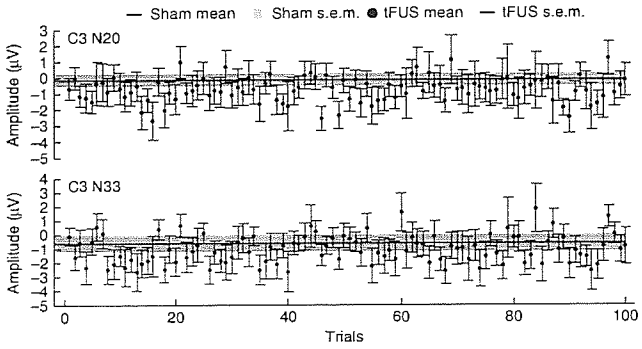

Figure 4 The influence of tFUS on brain activity is not cumulative and remains stable across time. Plots of the trial mean amplitudes for N20 and N33 components of SEPs recorded from C3 during tFUS treatment are plotted as a function of trial number. The tFUS trial data are plotted against the grand average mean ± s.e.m. of the N20 and N33 SEP amplitudes recorded during sham treatments. There were no cumulative effects of tFUS across trial number. Error bars represent s.e.m.

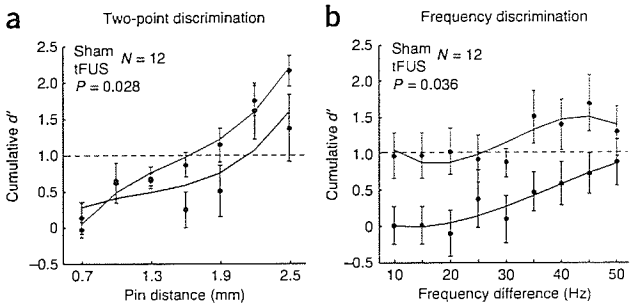

Figure 5 tFUS targeted to somatosensory cortex enhances sensory discrimination abilities in humans. (a) Data acquired under sham (black) and tFUS (red) treatments during two-point discrimination testing. The group average ($N = 12$) cumulative d' data show that the pin distance needed to achieve a threshold d' of 1 was lower for tFUS than for sham. (b) Data acquired under sham (black) and tFUS (red) treatments during frequency discrimination testing. The group average ($N = 12$) cumulative d' data show that the frequency separation to achieve a threshold d' prime of 1 was lower for tFUS treatment than for sham. Data from these psychophysical studies show that tFUS treatment significantly lowered sensory discrimination thresholds without affecting task attention or decision bias (see **Supplementary Fig. 2**). Error bars represent s.e.m.

SEP complexes recorded during tFUS and sham treatments when transducers were positioned 1 cm anterior or posterior to CP3 (**Fig. 6b** and **Supplementary Tables 2** and **3**). Spectral decomposition further confirmed this observation, as moving the transducer either to the anterior or posterior position yielded similar spectral profiles across tFUS and sham treatments (**Fig. 6b**). These similar spectral patterns are in contrast to our observations that tFUS targeted to S1 produced significant effects on the power of specific brain wave activity patterns. For example, when the acoustic beam was targeted to S1, we observed that tFUS significantly decreased the power of short-latency gamma-band activity occurring within 70 ms of MN stimulation (**Fig. 3**). When the acoustic field was focused 1 cm anterior or posterior to the postcentral gyrus, however, tFUS failed to produce a significant effect on short-latency evoked gamma activity (**Fig. 6b**).

Curiously, when the acoustic beam was targeted to the precentral gyrus (1 cm anterior of CP3) tFUS significantly increased the power of late-onset gamma-band activity occurring around 300 ms after MN stimulation (**Fig. 6b**). These results indicate that

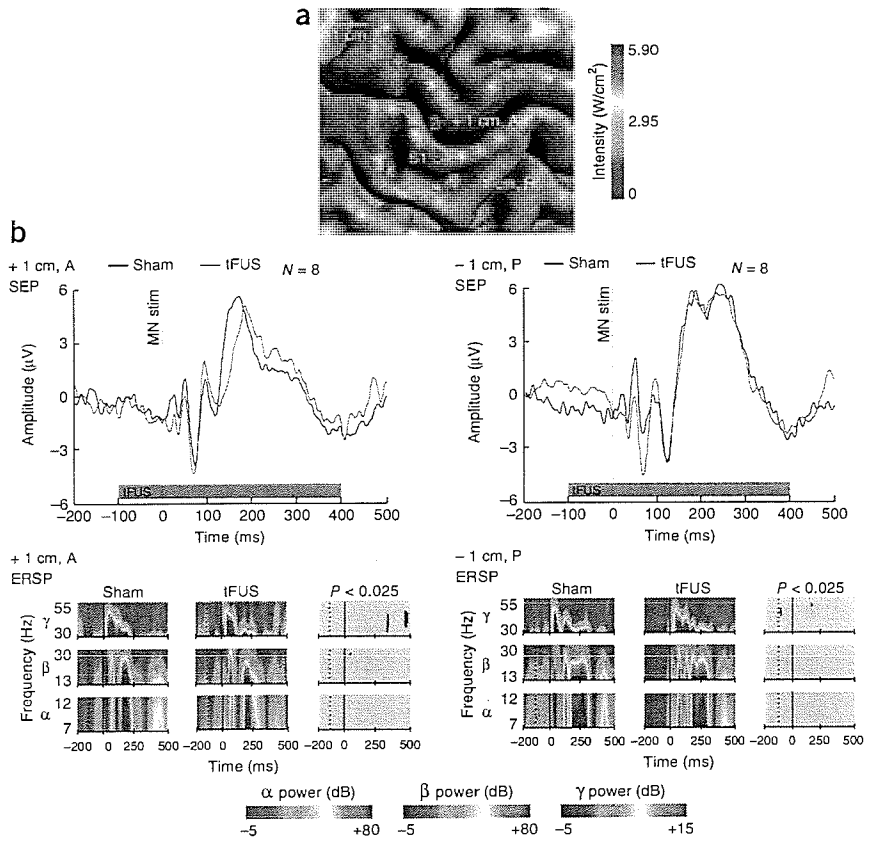

Figure 6 tFUS produces differential effects on sensory-evoked activity as a function of the brain region targeted. (a) Top-down view of the brain shows the spatial location of tFUS beams targeting the crown of the post-central gyrus (S1) and sites 1 cm anterior (+ 1 cm, A) and posterior (– 1 cm, P). (b) Top, SEP traces recorded from electrode C3 showing the grand average ($N = 8$) responses to right median nerve stimulation (MN stim; 100 trials) for sham (black) and tFUS (red) at 1 cm anterior (left) or 1 cm posterior (right) to S1. There were no significant peak-to-peak amplitude differences between sham and tFUS conditions when transducers were offset 1 cm from S1. Bottom, time-frequency plots illustrating the power of evoked brain oscillations in the alpha (7–12 Hz), beta (13–30 Hz) and gamma (30–55 Hz) frequency bands in relation to the onset of tFUS (dashed vertical line) and MN stimulation (solid vertical line) for sham and tFUS treatment conditions. Statistical difference plots are also shown for each frequency band: maroon regions indicate a significant difference ($P < 0.025$) between sham and tFUS conditions. Color scales indicate the power for each frequency band.

tFUS differentially affected short-latency evoked gamma activity, as well as late-onset induced gamma activity, as a function of the anatomical region targeted by the acoustic beam. Considering these anatomical and neurophysiological observations, we are led to conclude tFUS can modulate human cortical function while conferring a high spatial resolution in modular areas of cortex separated by about 1 cm or less. This spatial resolution of tFUS is better than those conferred by conventionally applied TMS or transcranial direct current stimulation (tDCS).

DISCUSSION

Using a single-element focused transducer, we show that 0.5-MHz US can be focused through human skull to produce acoustic beam profiles having a lateral spatial resolution of approximately 4.9 mm and an axial spatial resolution of about 18.0 mm from the focal distance. Our electrophysiological observations demonstrated that tFUS beams targeted to S1 could focally modulate short-latency and late-onset evoked cortical activity elicited in humans by somatosensory (median nerve) stimulation. Behavioral investigations revealed that tFUS targeted to S1 enhanced the somatosensory discrimination abilities of volunteers. Collectively, these observations demonstrate the utility of tFUS in the noninvasive modulation of human cortical function.

Targeting the spatiotemporal effects of tFUS

In the present study we implemented a sham condition, which controlled, as described above, for sounds made by the transducer when it was active. Subjects reported that the chirping sounds during sham and tFUS treatments were indistinguishable from one another. Further, they did not report any sensations specific to FUS transmission through their skin or skull. In contrast, however, we have previously shown that distinct US waveforms applied to the skin of the periphery can induce tactile and thermal sensations and differentially trigger brain activity patterns in sensory circuits[29]. Thus, it is important to distinguish several features of the tFUS waveform used in the present study from US waveforms we have previously used to stimulate the somatosensory periphery[29].

The pulse duration (360 μs) of the tFUS waveform used in the present study was too short and the pulse repetition frequency (1 kHz) too high to activate somatosensory receptors and fibers[29]. Through 64-channel EEG recordings, functional magnetic resonance imaging and subjective reports, we have previously shown that US waveforms must be tuned for the activation of specific somatosensory receptors or fibers located in human skin[29]. For example, in our previous studies we showed that low pulse repetition frequencies (10–70 Hz) and long pulse durations (7–10 ms) elicit vibratory or buzzing sensations transduced by skin receptors or mechanosensory fibers[29]. We also showed that thermal sensations can be elicited when delivering continuous wave US (100% duty cycle) to the skin for at least 1 s (ref. 29). It is therefore critical to recognize that US waveforms having different spatial peak and temporal average energy profiles can exert unique effects on a variety of cellular populations and neuronal structures[11,15,30,31]. The US waveform used in the present study was chosen partially for its inability to produce mechanical or thermal sensory effects on the skin or scalp.

In the present study we transmitted tFUS beams to the crown of the postcentral gyrus (S1) and posterior wall of the central sulcus. The projection of the acoustic beam path is consistent with our physiological observations that tFUS significantly affected the amplitudes of short-latency SEP complexes. This claim is supported by the fact that the short-latency SEP components in monkeys and humans are generated in S1 Brodmann areas 3b and 1 on the posterior wall of the central sulcus and crown of the postcentral gyrus[23,32]. When targeted to brain regions 1 cm posterior or 1 cm anterior to the postcentral gyrus, the effects of tFUS on evoked brain activity elicited by MN stimulation were abolished. In contrast, we have found that moving TMS coils in 1 cm or greater increments from a motor hotspot may not be sufficient to produce significant changes in the amplitudes of motor evoked potentials[33]. Our observations here show that the influence of tFUS on brain activity can be restricted to discrete modules of cortex located within 1 cm of each other. It is not yet known, however, whether US exerts its effects primarily on dendrites, axons or cell bodies of neurons. It will be important for future studies to examine these potential cellular sites of action, as tFUS may exert specific effects on anatomically distinct regions of the neuropil.

The temporal dynamics of US-induced changes in brain activity have been shown to have delayed onset kinetics when compared to those observed with other stimulation modalities, such as electrical stimulation[10]. In the present study, tFUS produced an effect on baseline alpha- and beta-band activity within 20 ms of US waveform transmission. This time course for the emergence of direct US-induced effects on baseline brain activity is consistent with previous electrophysiological and imaging observations made in rodents[10,11,15] and rabbits[16]. In the present study we aimed to determine whether tFUS could be used for targeted cortical modulation in humans by monitoring its influence on sensory-evoked brain activity. On the basis of the stability of SEP amplitudes recorded across tFUS trials, we conclude that there were no cumulative effects of tFUS on brain activity as studied here. Rather, we found the acute effects of tFUS on brain activity to be short-lived (<1 s). Both shorter and longer lasting effects of US on brain activity have been described, depending on numerous factors, including the US waveform characteristics implemented, as well as the anatomical and physiological features of the brain region targeted[10,11,14–16]. In chronic pain sufferers, for example, a transcranial US waveform (8 MHz for 15 s) transmitted through the temporal window to the human posterior frontal cortex leads to a reduction in pain ratings and improved mood for up to 40 min (ref. 34). Unraveling the spatial and temporal complexities underlying the ability of US to modulate brain activity will require further efforts.

Safety of tFUS

Ultrasound has not caused tissue damage in studies implementing its nonthermal bioeffects to modulate neuronal activity at acoustic intensities below those recommended for safe use in diagnostic imaging[5,9–11,15,16]. However, appropriate precautions and procedures must be followed to ensure the safe use of US for modulating human brain activity. To avoid the generation of standing waves, we followed the recommendations of O'Reilly *et al.*[35] and used a broadband, sharply focused US transducer operating in a pulsed wave mode. Others have also shown that the rate of tissue (cranium, skin and soft tissue) heating is slower and the likelihood of transient cavitation is reduced when using pulsed waves versus continuous wave US[35–39].

With respect to acoustic power, the I_{SPPA} of the tFUS waveform we used (23.87 W/cm^2) was below the 190 W/cm^2 maximum recommended limit for diagnostic imaging applications[36–38]. We also used short duration (500 ms) tFUS waveforms as stimuli, as this is not enough exposure time for relatively low-intensity pulsed US to produce appreciable tissue heating. Ultrasound at high intensities or during long exposures can cause irreversible tissue damage, like any energy source, so caution should be used when implementing it to modulate brain activity.

Physiological mechanisms underlying the effects of tFUS

Given the influence of tFUS on sensory-evoked brain activity, we naturally questioned whether it could affect sensory discrimination behavior. The psychological and neurobiological mechanisms underlying simple decisions[40] and sensory discrimination behaviors[41] are complex. Not surprisingly, it is therefore difficult to relate sensory evoked physiology to stimulus discrimination behaviors. In the present study we found that tFUS enhanced sensory discrimination performance on two-point and frequency discrimination tasks without altering task attention or decision bias. This improvement of sensory discrimination behaviors under tFUS treatment conditions may seem paradoxical, as tFUS produced a reduction in the amplitude of SEP complexes, but several mechanistic possibilities exist that can explain these observations.

The focal volume of the ellipsoid acoustic beam we implemented was approximately 0.21 cm^3 at half maximum field intensity. Within this volume the 500-ms pulsed acoustic pressure wave may locally shift the balance of excitation and inhibition by acting on mechanically sensitive components of the brain, including cell membranes, ion channels and synaptic vesicle cycles[42]. Our physiological observations suggest that tFUS transiently shifts the balance of neuronal activity in favor of local inhibition. Short-latency evoked gamma activity has been related to the N20 component of MN-elicited SEPs and is thought to represent cortical activity responsible for the initial encoding of a sensory stimulus[43,44]. Thus, one hypothesis consistent with the reduction of short-latency evoked gamma activity we observed during tFUS treatment is that the pulsed acoustic pressure waves dampen excitation or increase local interneuron firing and perhaps modulate the activity of fast-spiking interneurons. Stated differently, the same amount of incoming sensory activity from a MN stimulus could be acting on populations of neurons, which are under the influence of increased local inhibition triggered by tFUS.

As described above, the rendering of cortex less sensitive to sensory-encoding thalamocortical activity explains the reduction in SEP amplitudes we observed during tFUS treatment. Increased local inhibition produced by tFUS might serve as a filter by reducing the spatial spread of cortical excitation in response to MN stimulation or during sensory discrimination tasks. Such actions could theoretically result in more spatially restricted population activation patterns, thereby yielding improvements in the cortical representation of tactile stimuli. This hypothesis helps to explain the enhancement of somatosensory discrimination we observed in response to tFUS treatment. Several other mechanistic explanations certainly exist, so it is difficult to draw any definitive conclusions. Gaining a better understanding of how pulsed US affects the balance of inhibition and excitation in targeted brain regions, as well as how it influences the activity of local circuits versus long-range connections, will advance our ability to apply tFUS to the study and mapping of human brain circuits.

tFUS for functional brain mapping

One of the most enticing applications of tFUS is its emerging utility for noninvasive, functional brain mapping in humans. Here tFUS provides a highly focused energy source capable of noninvasively producing changes in human brain activity. In neurosurgical applications, transcranial high-intensity focused ultrasound (HIFU) was recently combined with magnetic resonance thermometry to heat and destroy the ventral intermediate nucleus of the thalamus for the successful treatment of essential tremor in awake, behaving patients[45]. During magnetic resonance–guided stereotactic targeting of HIFU beams (MRgHIFU), Elias *et al.*[45] observed that subablative heating of ventroposterolateral thalamic regions induced sensory effects, such as paresthesia of the lips and fingers, in some patients. However, subablative sonication events targeting the ventral intermediate region of the thalamus produced transient suppression of postural tremor, thereby providing a functional confirmation of the ablation target before lesioning with HIFU[45]. This functional mapping of deep-brain nuclei in humans with transcranial MRgHIFU enabled the active refinement of lesion coordinates such that ablation of the ventral intermediate nuclei could be achieved without destroying adjacent sensory regions of the thalamus.

The neuromodulation produced by MRgHIFU was elicited by focally heating deep-brain nuclei to around 48 °C for about 10 s during transcranial transmission of 0.65-MHz continuous-wave US at intensities <550 W/cm^2 from 1,024 transducers operating in a phased array[45]. In the present report, we describe an approach where lower intensity US (23.87 W/cm^2) transmitted from a single-element 0.5-MHz FUS transducer for 500 ms can be used to transiently modulate brain activity in the cortex of humans. Taken together, these observations highlight the potential of using tFUS for modulating and mapping brain function in both laboratory and clinical settings. Further studies are needed to validate and refine the thermal and nonthermal neuromodulation potential of tFUS. These rapidly evolving capabilities of tFUS should encourage changes in the way we study human brain function and support the exploration of new approaches to treating brain disorders. Thus, we anticipate many advances for neuroscience when extending the capabilities of tFUS for noninvasively modulating human brain circuits.

METHODS

Methods and any associated references are available in the online version of the paper.

Note: Any Supplementary Information and Source Data files are available in the online version of the paper.

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AUTHOR CONTRIBUTIONS

W.L., T.F.S., A.O., J.M., A.B., A.W. and W.J.T. performed the experiments; W.L., T.F.S., A.O. and W.J.T. wrote the manuscript; W.L., T.F.S., A.O. and W.J.T. conducted the data analyses; W.J.T. supervised the project.

COMPETING FINANCIAL INTERESTS

The authors declare competing financial interests: details are available in the online version of the paper.

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ONLINE METHODS

Quantitative acoustic field mapping. We measured the acoustic intensity profile of the waveform using a calibrated hydrophone (HNR-0500, Onda Corporation, Sunnyvale, CA) whose signal was amplified by an AH-1100 preamplifier (Onda Corporation). The hydrophone, US transducer and skull fragment were positioned within a 58-l acrylic water tank. The hydrophone was mounted on a three-axis stage (LTS300, Thorlabs Inc, Newton, NJ) using an assortment of optomechanical components (Edmund Optics Inc., Barrington, NJ and Thorlabs Inc., Newton, NJ). The US transducer and skull fragment were positioned similarly. Custom software written in LabVIEW (National Instruments, Austin, TX) was used to control the three-axis stage as well as the timing of transducer excitation and recording of the corresponding waveform as measured by the hydrophone. Acoustic field scans were performed at 400 μm (2 to 122 mm from transducer in a 10.4 mm × 10.4 mm region) and 200 μm (2 to 72 mm from transducer in a 5.6 mm × 5.6 mm region). For finding the final focal plane as well as the spatial peak location, the field maps, obtained from the earlier scans were used as locators for conducting 100-μm-resolution scans. Scans around the axis (*z* axis) were first performed to find the focal distance; next, a 12 mm × 12 mm scan was performed at this distance to obtain an *x*-*y* acoustic power map at the focal plane. Scans were first performed without the skull between the transducer and hydrophone. Subsequently, to test the effects of a human skull on FUS fields, we inserted a 6-mm-thick fragment of human cortical bone (rehydrated for 48 h) between the transducer and the hydrophone and repeated our scans using the same procedures, except that the starting distance to the transducer was increased to 10 mm to avoid collision between the skull and hydrophone.

Projection of tFUS fields into a realistic head model. A realistic head FEM model was created using SimNibs[46]. Briefly, gray matter, white matter, CSF, skin and skull were segmented from the magnetic resonance images and, on the basis of the binary tissue masks, a three-dimensional FEM model of the head was created containing approximately 1.7 million tetrahedral elements, with higher resolution inside white matter and gray matter. To estimate the acoustic field distribution in the brain during US stimulation, the measured tFUS field (**Fig. 2b**) was projected into the brain assuming that the face of the transducer was placed tangential to the scalp over CP3, as in our EEG experiments described below. The density of brain was specified as 1,030 kg/m^3 and the speed of sound was 1,550 m/s (ref. 47). Acoustic intensity in the mesh nodes was computed using a nearest-neighbor interpolation. It was assumed that the acoustic properties of gray matter, white matter and CSF were similar enough that effects due to impedance mismatch at the tissue interfaces were negligible.

tFUS waveform. Transcranial ultrasonic neuromodulation waveforms were generated using a two-channel, 2-MHz function generator (BK Precision Instruments) as previously described[48,49]. Briefly, channel 1 was set to deliver US at a pulse repetition frequency (PRF) of 1.0 kHz and channel 2 was set to drive the transducer at a 0.5 MHz acoustic frequency (A_f) in a bursting mode, with channel 1 serving as an external trigger for channel 2. The pulse duration (PD) of the waveform was set to 0.36 ms by adjusting the number of cycles per pulse (c/p) on channel 2 to 180, and the stimulus duration (0.5 s) was set by adjusting the number of pulses (np) on channel 1 to 500. The output of channel 2 was sent through a 40-W linear RF amplifier (E&I 240L; Electronics & Innovation) before being sent to a custom-designed focused ultrasound transducer (Blatek, Inc., State College, PA) having a center frequency of 0.5 MHz, a diameter of 30 mm and a focal length of 30 mm. The waveform employed for tFUS stimulation had the following parameters: A_f = 0.50 MHz, PD = 360 μs, PRF = 1.0 kHz and np = 500. This produced a stimulus duration of 0.5 s yielding a peak rarefactional pressure of 0.80 MPa, a mechanical index of 1.13 and a spatial-peak pulse-average intensity (I_{SPPA}) of 23.87 W/cm^2 before transcutaneous and transcranial transmission. We have previously verified this waveform does not produce heating of the skin or skull bone. The transducer was coated with acoustic coupling gel and placed on the scalp at the 10-20 electrode location CP3 before being secured in place with athletic prewrap bandaging.

Characterizing the effects of tFUS on sensory-evoked brain activity. *Participants.* The Institutional Review Board at Virginia Tech approved all experimental procedures. Ten volunteer study participants (5 male, 5 female, aged 18–47 with a mean age of 27.0 ± 9.5 years) provided written informed consent to participate in the study. None of the volunteers reported any neurological impairment and were all self-reported as right-hand dominant.

Experimental setup. Participants were seated in a high-back desk chair with their right forearm fully supported in supination. During testing, subjects were required to sit passively while viewing a fixation cross on a screen. A total of 120 ultrasonic waveforms (see below) were delivered from the 10–20 EEG electrode site CP3 at an inter-stimulus interval (ISI) of 6 s with a positive randomization of 4 s. The tFUS treatment condition involved acoustically coupling the active face of the ultrasound transducer to the scalp at EEG site CP3 using ultrasound gel. The sham condition involved having the US transducer coupled to the head at CP3, but flipped upside down such that the inactive face of the transducer (symmetrical to the active face) made contact with the scalp but ultrasonic energy was not transmitted into the head. This approach was used to account for a chirping sound when the transducer was active. This chirping sound was identical for both the sham and tFUS conditions, and no subjects reported any sensory or perceptual differences between the two conditions. The order of sham or tFUS treatment was randomized for each subject. Total collection time was approximately 1 h.

Electroencephalography. Electroencephalography (EEG) data were acquired using a DC amplifier (BrainAmp MR Plus, Brain Products GmbH, Gilching, Germany) with four 10-mm gold-over-silver cup electrodes placed at electrodes sites C1, CP1, CP5 and P3 referenced to the left mastoid and grounded to the left ulnar styloid process. Cup electrodes were filled with a conductive paste (Ten20 Conductive; Weaver and Company, Aurora, CO) and held in place with tape. The scalp was first prepared with a mild abrasive gel (Nuprep; Weaver and Company, Aurora, CO) and rubbing alcohol. Electrode impedances were verified (<5 kΩ) before recording. EEG data were on-line filtered (DC–200 Hz) and digitized at 1,000 Hz before being stored on a computer for subsequent off-line analysis. Somatosensory evoked potentials (SEPs) were elicited in response to right median nerve stimulation using a 0.2-ms square-wave pulse driven by an SD-9 stimulator (Grass Technologies, Warick, RI) delivered through a bar electrode (2 cm electrode spacing) affixed to the wrist. Intensity was adjusted to elicit a slight twitch of the thumb. Stimuli were delivered at an inter-stimulus interval of 6 s with a 4-s positive randomization. In each treatment condition, a total of 120 MN stimuli were delivered, of which, owing to artifact rejection in analyses, 100 random EEG responses to stimuli were used. Median nerve stimuli were time-locked to occur 100 ms after the onset of tFUS waveforms (**Supplementary Fig. 1b**). The experimenters conducting experiments were not blinded to the experimental condition, but the researcher processing and analyzing the acquired EEG data was.

Statistical analysis of somatosensory evoked potentials. EEG data were preprocessed using EEGLAB v12.0.0.0b[50] and Matlab v7.10.0 (The MathWorks, Inc., Natick, MA). Data were band-pass filtered (2–90 Hz) and notch filtered (60 Hz). Data were epoched around median nerve stimulus (−200 to 500 ms) and baseline corrected (−200 to −100 ms). Data were inspected for artifacts using automatic rejection criteria of an absolute peak-to-peak amplitude of 75 μV and 60 μV/ms. Waveform peak amplitude and latency were identified and quantified using custom software written in LabVIEW (National Instruments, Austin, TX, USA). All classically defined SEP components were assessed. This included the N20, P27, N33, P50, N70, P100, N140 and late potential (LP). The LP was defined as the positive (CP1 and C3) or negative (CP5 and P3) potential with a latency in the 200 ms range (**Fig. 3**). A distinct inflection of the waveform was necessary for inclusion in statistical analyses. Statistical analyses were performed on mean peak-to-peak amplitudes for the N20/P27, N33/P27, P50/N33, N70/P50, P100/N70, N140/P100 and LP components of SEPs recorded during sham and tFUS treatment conditions (n = 10 subjects, 100 trials each for each condition). To statistically analyze these SEP components recorded from multiple electrodes and at different time regions of interest, we used nonparametric permutation statistics, which appropriately control for multiple comparisons problems encountered in analyses of complex EEG data sets[51]. Randomization tests were conducted similarly to those described in ref. 51, where statistical P values represent the proportion of 1,000 random partitions resulting in a test statistic larger than the t value calculated by a conventional paired t-test (two-tailed, d.f. = 9) on the data.

$P < 0.025$ was considered statistically significant. Values for SEP amplitudes are reported as mean ± s.e.m.

To assess the immediacy and stability of the effects exerted by tFUS on the amplitudes of SEP potentials, we quantified data for individual trials for each subject for both tFUS and sham conditions. Because we were unable to reliably detect SEP peaks from individual trials, amplitude was quantified from set time windows centered on peak latency of each potential of interest (i.e., N20 = 20 ms) with a time envelope approximated to the full-width half maximum of the potential of interest rounded to the nearest millisecond quantified from the grand average ($n = 10$) trace recorded from electrode site C3. Thus, for example, N20 amplitude for each trial was taken as the average from time points 18 to 22 ms. Data points from each time window were averaged to create a single value for each potential of interest for each trial. These data were averaged across each subject ($n = 10$) and are presented as mean ± s.e.m. for both tFUS and sham condition.

Statistical analysis spectral content. We conducted spectral analysis using Matlab v7.10.0 (The MathWorks, Inc., Natick, MA). Spectral decomposition measures average dynamic changes in amplitude of a broadband EEG frequency spectrum as a function of time relative to an experimental event[52]. Spectral content was calculated using a short-time Fourier transform with a window size of 50 ms and a 25 ms overlap. Each segment was windowed with a Hamming window. The color of each pixel in the generated spectral image then indicates the power (dB) at a given frequency and latency. Here spectral decomposition was performed on the raw online DC–200 Hz filtered data. For reasons cited above, statistical tests on the spectra between tFUS and sham conditions were conducted using nonparametric permutation statistics with a temporal cluster threshold of 13.4 ms and a $P < 0.025$, controlling for multiple comparisons as described by ref. 51. Data are presented parsed into the following frequency bands (**Fig. 4**): alpha band (7–12 Hz), beta band (13–30 Hz) and gamma band (30–55 Hz).

Examining the spatial specificity of tFUS on sensory-evoked brain activity. *Participants.* Eight volunteer participants (6 male, 2 female, aged 22–57 with a mean age of 28.8 ± 11.6 years) provided written informed consent to participate in the study. None of the volunteers reported any neurological impairment and were all self-reported as right-hand dominant.

Experimental setup. The set-up and approaches were identical to those described above. However, tFUS was projected from transducers placed at sites 1 cm anterior and 1 cm posterior to CP3 during MN stimulation trials. Both anterior and posterior sites were collected in the same session. Placement of the transducer (anterior versus posterior) as well as treatment condition (tFUS versus Sham) was pseudorandomly assigned among subjects such that either anterior or posterior placement was collected first in half of the subjects.

The influence of tFUS on two-point discrimination behavior. *Participants.* Twelve volunteer participants (5 male, 7 female, aged 23–57 with a mean age of 30.4 ± 10.4 years) provided written informed consent to participate in the study. None of the volunteers reported any neurological impairment and all were self-reported as right-hand dominant.

Experimental setup. Subjects were seated in a desk chair with their right arm resting on a tabletop with the pad of their index finger resting over a 1.3-cm hole through which stimuli were delivered. A total of nine pin (diameter = 200 μm) separation distances were used including (0, 0.7, 1.0, 1.3, 1.6, 1.9, 2.2, 2.5, 2.8 mm). Each pin distance was randomly applied at a constant force of 1 N to the fingertip ten times during tFUS or sham treatment. After each stimulus, participants were required to report verbally whether they felt one or two pins. Before formal testing, participants were familiarized with the sensations produced by pins separated by 0 (one pin), 1.6 and 2.8 mm and informed after each stimulus to the fingertip whether the stimulus was one or two pins. Practice sessions of 10 trials of each pin distance (0, 1.6 and 2.8) were conducted. Formal testing began once participants achieved 80% (8/10) correct responses in response to stimulation using 0 mm and 2.8 mm pin distances. Participants were not aware of how many pin distances were used or the ratio of single to double pins during formal testing. Participants were not allowed to look at their fingers, but they were allowed to have their eyes open or closed. It was not possible for the participant to see the pins, as they were occluded from view under a table.

A custom-made motorized device that was controlled by custom-made software (LabVIEW, National Instruments, Austin, TX) was built to apply the pin to the fingertip. This allowed for precisely controlled force (1 N) and duration (250 ms) of the pins to the fingertip. The software also timed the onset of tFUS (500 ms duration) to occur 100 ms before the pin application to the fingertip. Participants underwent the sensory discrimination testing during both tFUS and sham treatment conditions in the same testing session. The order of sham or tFUS treatment was counterbalanced across subjects. The tFUS methods and parameters were identical to those reported earlier. Total collection time was approximately 1 h.

Statistical *analysis.* Signal detection theory was used to assess two-point discrimination thresholds as previously described[53]. In this case, a two-response (one pin or two pin) design was used. Signal detection theory provides for the analysis of the two stages of information processing: (i) signal processing from sensory evidence and (ii) the decision whether the signal is present or not. Signal detection theory thus provides measures of participants' true sensitivity (d') and their bias for responding a certain way (c). To assess sensitivity, each participants' percentage correct at each pin distance was calculated. In instances where accuracy was 1 or 0, proportions were adjusted by $1/(2N)$ and $1/(1 - 2N)$, respectively, where N is the number of trials per condition. Data were z-score transformed and analyzed using two-response classifications and cumulative d' values as previously described[53]. The detection threshold was chosen as $d' = 1$. Thus, this is the smallest pin distance that can be determined by a d' of 1. d' data were fitted using a third-degree polynomial. To assess threshold differences between tFUS and sham stimulation, the pin distance where each participant first achieved a d' prime >1 was recorded for both tFUS and sham and subjected to a Wilcoxon rank sum test for statistical significance. To determine if responder bias contributes to the perceptual results, the criterion value c was calculated using the data from the one-pin and two-pin trials with the formula $c = 0.5[z(\mathrm{H}) + z(\mathrm{FA})]$ (ref. 53), where z is the inverse of the normal cumulative distribution function, H is hit rate and FA is the false alarm rate. H was defined as responding one pin when one pin was present plus responding two pins when two pins where present. FA was defined as responding two pins when one pin was present. A criterion value of 0 reflects no bias for responding. Negative values indicate a tendency to report a stimulus when there is none (FA) and positive values the opposite. In this case, a positive value reflects a tendency toward saying two pins when there was only one and a negative value a tendency toward saying one pin when there were two. The parameter c was calculated for each subject for both the tFUS and sham session and subjected to a Wilcoxon rank-sum test for statistical significance. In addition, the percentage correct (hits/total trials) for the one-pin trials were quantified for both tFUS and sham conditions and statistical significance was assessed using a Wilcoxon sign-rank test.

The influence of tFUS on sensory discrimination behavior during frequency discrimination tasks. *Participants.* Twelve subjects (5 male, 7 female, aged 20–57 with a mean age of 31.8 ± 11.8 years) provided written informed consent to participate in the study. None of the volunteers reported any neurological impairment or neuropathic condition, and all were self-reported as right-hand dominant.

Experimental setup. The physical setup was similar to above. Subjects' right index finger rested on a 1.3-cm-diameter opening in which air puff stimuli were delivered. Air puff stimuli were generated using a Picospritzer III (Parker Instruments, Cleveland, OH) with a constant pressure of 14.5 p.s.i. delivered through a 1.88-mm-diameter aperture that contacted the volar surface of the index finger. This translated to a force of 0.3 N applied to the fingertip. A two-alternative forced choice method was employed in which the first stimulus was always a constant frequency of 100 Hz and the second stimulus was either the same frequency or higher. Participants were required to orally respond after cessation of the second stimulus "higher" if they thought the second stimulus was higher in frequency or "same" if they thought it was the same. The experimenter recorded the response on a computer. Ten frequencies were used from 100 Hz to 150 Hz in 5-Hz steps. The stimulus duration was 500 ms and the inter-stimulus interval was 500 ms. A total of 120 pairs of stimuli were delivered at an average inter-trial interval (ITI) of 6 s. A total of 40 catch trials (100 Hz–100 Hz) were randomly delivered throughout the test protocol. The ITI was not constant owing to varying response times of the participants.

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The timing of stimuli was controlled by a custom-made program in written in LabVIEW (National Instruments, Austin, TX). The program also controlled the timing of tFUS such that it was delivered at the onset of the second air puff stimulus. Ultrasound waveform parameters were identical to those reported under "tFUS waveform" above. Before formal testing, participants were familiarized with the air puff stimuli at 100, 125 and 150 Hz. Practice sessions were conducted until participants achieved an 80% success rate on the maximally separated 100–150 Hz pair. Participants were not aware of how many frequency differences were used or the ratio of same to different frequencies. Participants were not allowed to look at their fingers, but they were allowed to have their eyes open or closed. Participants were provided with headphones that played white noise to block any auditory cues from the air puffer apparatus.

Statistical analysis. Signal detection theory was used to assess frequency discrimination thresholds, similarly to the method reported for two-point discrimination. Briefly, each volunteer's percentage correct at each frequency difference was calculated. In instances where accuracy was 1 or 0, proportions were adjusted by $1/(2N)$ or $1/(1-2N)$, respectively, where N is the number of trials per condition. Data were z-score transformed and analyzed using two-response classification and cumulative d'. Detection threshold was chosen as $d' = 1$. Data were fitted using a third-degree polynomial. The frequency difference where each participant first achieved a cumulative $d' > 1$ was recorded for both tFUS and sham and subjected to a Wilcoxon rank-sum test for statistical significance. In addition, the percentage correct (hits/total trials) for the same frequency trials was quantified for both tFUS and sham conditions and statistical significance was assessed using a Wilcoxon sign-rank test.

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Remote Excitation of Neuronal Circuits Using Low-Intensity, Low-Frequency Ultrasound

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Abstract

Possessing the ability to noninvasively elicit brain circuit activity yields immense experimental and therapeutic power. Most currently employed neurostimulation methods rely on the somewhat invasive use of stimulating electrodes or photon-emitting devices. Due to its ability to noninvasively propagate through bone and other tissues in a focused manner, the implementation of ultrasound (US) represents a compelling alternative approach to current neuromodulation strategies. Here, we investigated the influence of low-intensity, low-frequency ultrasound (LILFU) on neuronal activity. By transmitting US waveforms through hippocampal slice cultures and *ex vivo* mouse brains, we determined LILFU is capable of remotely and noninvasively exciting neurons and network activity. Our results illustrate that LILFU can stimulate electrical activity in neurons by activating voltage-gated sodium channels, as well as voltage-gated calcium channels. The LILFU-induced changes in neuronal activity were sufficient to trigger SNARE-mediated exocytosis and synaptic transmission in hippocampal circuits. Because LILFU can stimulate electrical activity and calcium signaling in neurons as well as central synaptic transmission we conclude US provides a powerful tool for remotely modulating brain circuit activity.

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Introduction

Neuromodulation techniques such as deep brain stimulation (DBS) and repetitive transcranial magnetic stimulation (rTMS) have gained widespread attention due to their therapeutic utility in managing numerous neurological/psychiatric diseases [1]. The field of neural control has recently made significant advances by demonstrations of millisecond optical control of individual neurons and synapses in intact brain circuits [2]. Ultrasound (US) as a means of exciting [3] and reversibly suppressing [4] neuronal activity was shown to be effective on a gross level several decades ago. Since then however, explorations into the use of US as a neurostimulation tool have been relatively sparse. The focus has instead been on employing more traditional approaches such as pharmacological, electrical, magnetic, and photonic stimulation of neuronal circuits.

Coupling its ability to interact with biological tissues [5] and its noninvasive transmission through skull bone and other biological tissues in a focused manner [6–8], US holds promise as a potentially powerful neurostimulation tool [9,10], which may be capable of replacing currently invasive DBS strategies. Ultrasound can produce bioeffects by acting through thermal and/or non-thermal mechanisms as it propagates through tissues in pulsed or continuous waveforms [5,11–13]. Therapeutic US can be broadly characterized as low-power/low-intensity or high-power/high-intensity [5]. High-intensity focused ultrasound (HIFU) used in the thermal ablation of tissue implements peak power levels often exceeding 1000 W/cm^2, whereas non-thermal therapeutic effects of US have been well described at power levels ranging from 30–500 mW/cm^2 [5,11–13].

Modulation of ionic conductance produced by adiabatic processes as US propagates rapidly and transiently through cellular membranes may alter the activity of individual neurons due to the elastic nature of lipid bilayers and the spring-like mechanics of many transmembrane protein channels. In partial support of this hypothesis, low-power US has been shown to influence the membrane conductance of frog skin epidermis [12]. In addition, US exposure can induce a reversible increase in the internal Ca^{2+} concentration of fibroblasts [14]. In rat thymocytes, stimulation with US can modulate K^+ influx and efflux [15]. Interestingly, many voltage-gated ion channels, as well as neurotransmitter receptors possess mechanosensitive properties that render their gating kinetics sensitive to transient changes in lipid bilayer tension [16,17]. Whether or not ion channels can be modulated by US in neurons has remained unknown. Several investigations have demonstrated however that US modulates neuronal activity by enhancing and/or suppressing the amplitudes and/or conduction velocities of evoked nerve potentials [3,4,18–24].

In a pioneering study, Fry and colleagues (1950) first demonstrated US is capable of modulating neuronal activity by reporting the temporary suppression of spontaneous activity following US transmission through crayfish ventral nerve cords [24]. Transmitting US through the lateral geniculate nucleus of intact cats, Fry and colleagues (1958) demonstrated that high-power US reversibly suppressed light-evoked potentials recorded

in the visual cortex [4]. Rinaldi and colleagues (1991) demonstrated that 2.5 to 15 min irradiation of hippocampal slices with 0.75 MHz US (temporal average intensity; I_{TA} ~80 W/cm^2), significantly reduces the amplitude of evoked potentials in CA1 pyramidal neurons. In the dentate gyrus of hippocampal slices, focused US pulses have been shown to both enhance and suppress electrically evoked field potentials [21]. In cat saphenous nerve bundles it has been demonstrated that focused US is capable of differentially effecting Aδ- and C-fibers depending on the intensity and duration of US irradiation [23]. In excised frog sciatic nerve bundles, Tsui and colleagues (2005) reported that a temporal average intensity of 1 W/cm^2 continuous wave (5 min) US (3.5 MHz) increased the amplitude of compound action potentials (CAP), while both 2 and 3 W/cm^2 intensities decreased CAP amplitudes. Mihran and colleagues (1990) also reported differential excitatory and inhibitory effects of US on frog sciatic CAPs using relatively short irradiation times by delivering 500 μs US pulses (2.0–7.0 MHz) with peak intensities ranging from 100–800 W/cm^2. Direct activation of the cat auditory nerve has been achieved *in vivo* using 5-MHz US pulses (68 μsec; ~30 W/cm^2) [22]. In human subjects, focused US pulses have been shown to activate deep nerve structures in the hand by differentially producing tactile, thermal, and pain sensations [3].

Although numerous intriguing studies examining the influence of US on neuronal activity have been conducted, these previous investigations have implemented high-intensity US, which can destroy nervous tissue. Thus, we decided to investigate the influence of low-intensity ultrasound on neuronal activity. Most of the prior investigations examining the effect of US on neuronal activity also used high-frequency US (>1 MHz; for exceptions see [3,20,21]), which has larger attenuation coefficients compared to lower frequency ultrasound. Medical diagnostic US typically operates from 1 to 15 MHz while therapeutic US is usually conducted using acoustic frequencies around 1 MHz [11]. We chose to pursue our investigations here using low-frequency US (0.44–0.67 MHz) since both mathematical models and experimental data indicate the optimal gain between transcranial transmission and brain absorption for US is ~0.60–0.70 MHz [25,26]. Detailed cellular investigations into the influence of US on neuronal activity are lacking and the mechanisms underlying US modulation of neuronal activity remain unknown. By optically monitoring changes in ionic conductance in individual neurons and synaptic transmission from individual release sites we investigated the influence of low-intensity, low-frequency ultrasound (LILFU) on central nervous system activity.

Results

LILFU activates voltage-gated sodium channels in neurons

We transmitted LILFU waveforms through hippocampal slice cultures from remotely positioned tissue-matched piezoelectric (PZT) transducers (Figure 1A). We constructed LILFU waveforms by repeating US tone bursts at variable pulse repetition frequencies (Figure 1B). Measured using a needle hydrophone a points in the recording chamber, which corresponded to slice positions (Figure S1), the predominant LILFU waveform used in our studies (LILFU-1) had a pulse average intensity (I_{PA}) of 2.9 W/cm^2 and a temporal average intensity (I_{TA}) of 23 mW/cm^2. Figure 1C illustrates a typical pressure wave obtained for a single US tone burst used in the construction of LILFU-1.

By imaging organotypic hippocampal slice cultures bath-loaded with the Na^+ indicator CoroNa Green AM [27], we found LILFU-1 triggered Na^+ transients in hippocampal CA1 pyramidal neurons ($\Delta F/F_0$ = 0.05±0.006, n = 24, 6 slices; Figure 2A). Addition of the voltage-gated Na+ channel pore blocker tetrodotoxin (TTX; 1 μm), blocked Na^+ transients evoked by LILFU-1 (Figure 2A). These observations indicate that LILFU-1 increased the Na^+ conductance in hippocampal neurons by stimulating the opening of voltage-gated Na^+ channels. We next aimed to determine if LILFU waveforms were also capable of triggering action potentials in CA1 pyramidal neurons. Indeed, we observed single action potentials in response to

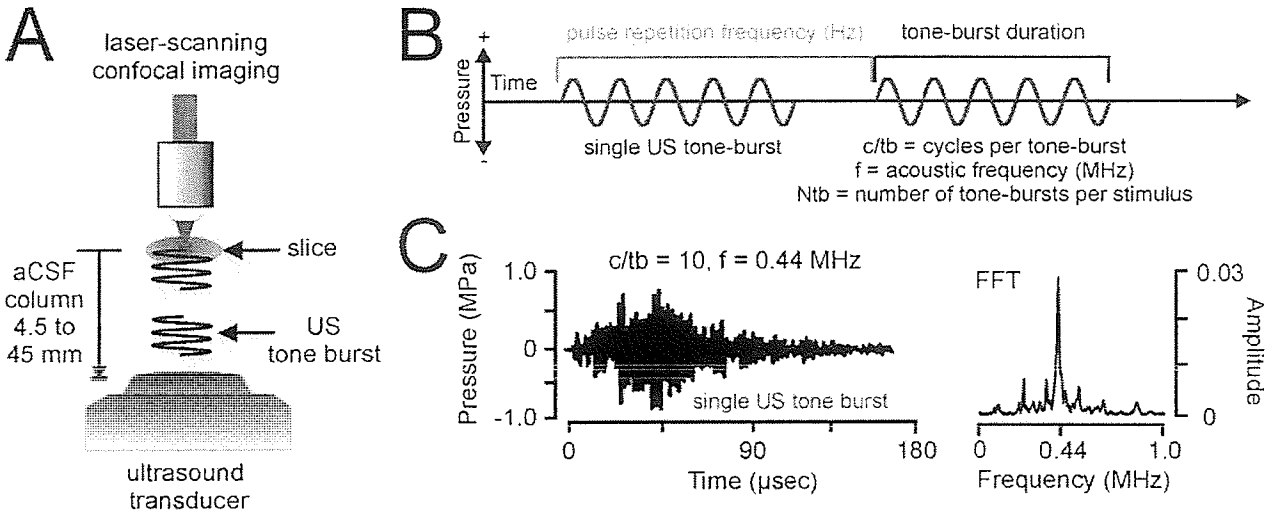

Figure 1. Generation and propagation of LILFU waveforms through neuronal tissue. (A) General experimental configuration implemented to transmit LILFU waveforms through slice cultures while optically monitoring neuronal activity. (B) Graphical illustration of some of the variables involved in constructing LILFU waveforms. These variables include acoustic frequency (f), the number of acoustic cycles per tone burst (c/tb), tone burst duration (TBD), pulse repetition frequency (PRF), and number of tone bursts per stimulus (Ntb). (C) Acoustic pressure wave (*left*) produced by a typical US tone burst consisting of 10 acoustic cycles at f = 0.44 MHz and FFT of this US tone burst (*right*). For the construction of our primary US stimulus waveform (LILFU-1), we used a linearly sweeping PRF by repeating the illustrated tone burst from 0–100 Hz over a 5 sec period.
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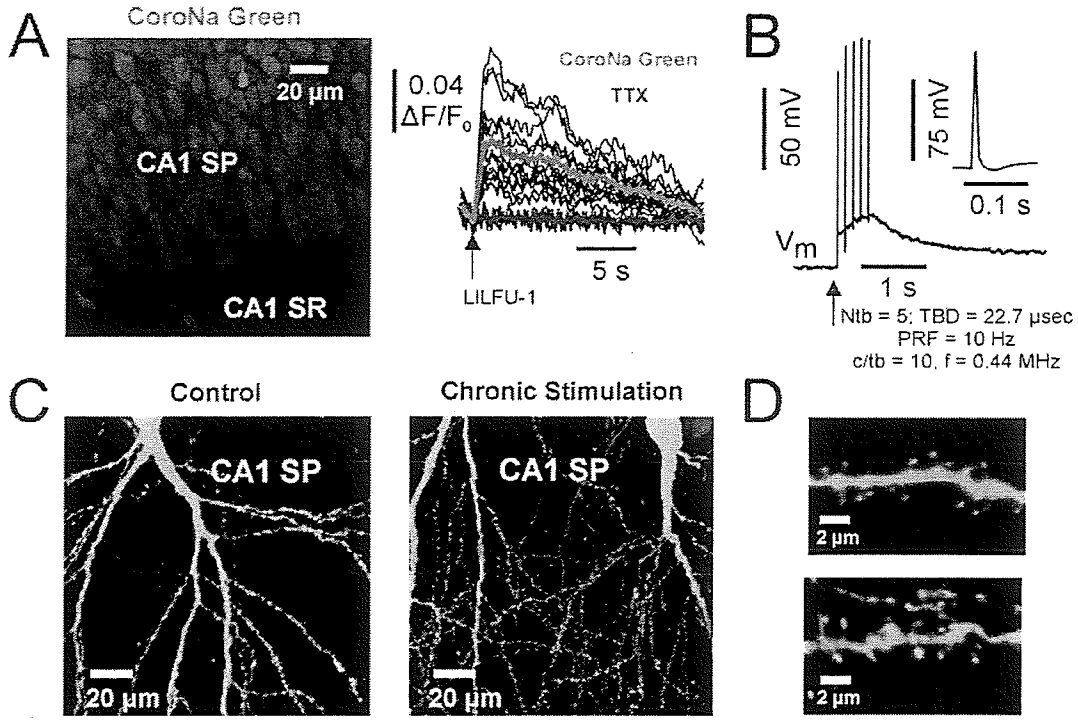

Figure 2. LILFU stimulates sodium transients mediated by voltage-gated sodium channels in hippocampal neurons. (A) Confocal image (*left*) of a slice culture loaded with CoroNa Green AM. Hippocampal regions CA1 *stratum pyramidale* (SP) and *stratum radiatum* (SR) are illustrated. Individual (*black*) and averaged (*color*) Na^+ transients (*right*) triggered in CA1 pyramidal neuron somas by LILFU-1 under control conditions and in the presence of TTX. (B) Voltage trace of membrane voltage in response to five US tone bursts delivered at a PRF of 10 Hz during whole-cell current clamp recordings of a CA1 pyramidal neuron. (C) Neuronal membrane integrity is preserved following chronic *in vitro* stimulation with LILFU. Confocal images of CA1 pyramidal neurons from hippocampal slice cultures prepared from *thy-1*-YFP mice. The images shown are from a control slice culture (*left*) and a slice culture following chronic stimulation (*right*) with LILFU-1 every 8 min for 48 h (360 LILFU-1 stimuli). (D) Similar to (C), but higher magnification images of regions in CA1 SR, which more clearly illustrate the presence of fine membrane structures such as dendritic spines for control (*top*) and chronic LILFU stimulation conditions (*bottom*).
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the delivery of individual LILFU tone bursts during whole-cell current clamp recordings of CA1 pyramidal neurons (n = 4, 4 slices; Figure 2B). We determined however, whole-cell electrophysiological approaches were not very useful in studying the influence of US on neuronal activity since electrode resonances typically cause the loss of whole-cell seals during stimulation with LILFU. Thus, we continued our investigations using standard optophysiological approaches.

Cavitation is one of the best studied non-thermal effects of US on biological tissue [13,28]. Acoustic cavitation can occur when the intensity of US is sufficient to induce the resonation, expansion, and collapse of gas bodies present in some biological tissue. These microexplosions can influence membrane porosity [12,13]. Monitored using optical microscopy during LILFU stimulation, we did not observe cavitation in our studies. Additionally, at the acoustic intensities used in our studies, we did not observe other evidence of membrane damage produced by LILFU stimulation. To examine the effect of LILFU on membrane integrity, we chronically stimulated slice cultures prepared from *thy-1*-YFP mice [29] with LILFU-1 every 8 min for 36–48 hours. We observed no difference in the membrane structures of YFP^+ neurons undergoing chronic stimulation compared to unstimulated controls (n = 9 slices each; Figure 2C, 2D).

LILFU stimulates voltage-dependent calcium transients in neurons

To determine if LILFU waveforms were capable of activating Ca^{2+} transients, we bath-loaded slice cultures prepared from wild-type mice with the Ca^{2+} indicator Oregon Green 488 BAPTA-1 AM (OGB-1 AM) and Sulforhodamine 101 (to differentiate between neurons and glial cells) as previously described [30]. We found that LILFU-1 activated Ca^{2+} transients in both hippocampal pyramidal neurons ($\Delta F/F_0 = 1.14 \pm 0.10$, n = 61, 10 slices) and glial cells ($\Delta F/F_0 = 1.40 \pm 0.12$, n = 55, 10 slices; Figure 3A and Video S1). Highlighting temporal specificity, stimulation with more brief LILFU waveforms (f = 0.44 MHz, TBD = 0.18 msec, c/tb = 80, PRF = 10 Hz, and Ntb = 3), elicited neuronal Ca^{2+} transients ($\Delta F/F_0 = 0.38 \pm 0.02$, n = 24, 5 slices) with faster kinetics as expected (Figure 3B). In response LILFU stimulation, we observed that Ca^{2+} transients could be repeatedly obtained from neurons across multiple LILFU stimulation trials (Figure 3B). While we primarily focused on small regions of interest during stimulation, when we imaged large fields of view we observed that approximately 30% of the neurons respond to LILFU-1. Stimulation with LILFU-1 also induced presynaptic Ca^{2+} transients in *en passant* boutons located in CA1 SR ($\Delta F/F_0 = 0.76 \pm 0.07$, n = 31 from 4 slices; Figure 3C). Addition of Cd^{2+} (500 µM) nearly abolished OGB-1 signals in response to LILFU-1, indicating Ca^{2+} transients triggered by LILFU are primarily mediated by voltage-gated Ca^{2+} channels (Figure 3D). Likewise, the addition of TTX blocked ~85% of the OGB-1 signal produced by LILFU-1 (Figure 3D). Residual Ca^{2+} transients not blocked by Cd^{2+} or TTX are likely to involve other hippocampal neuron Ca^{2+} sources such as NMDA or TRPC1

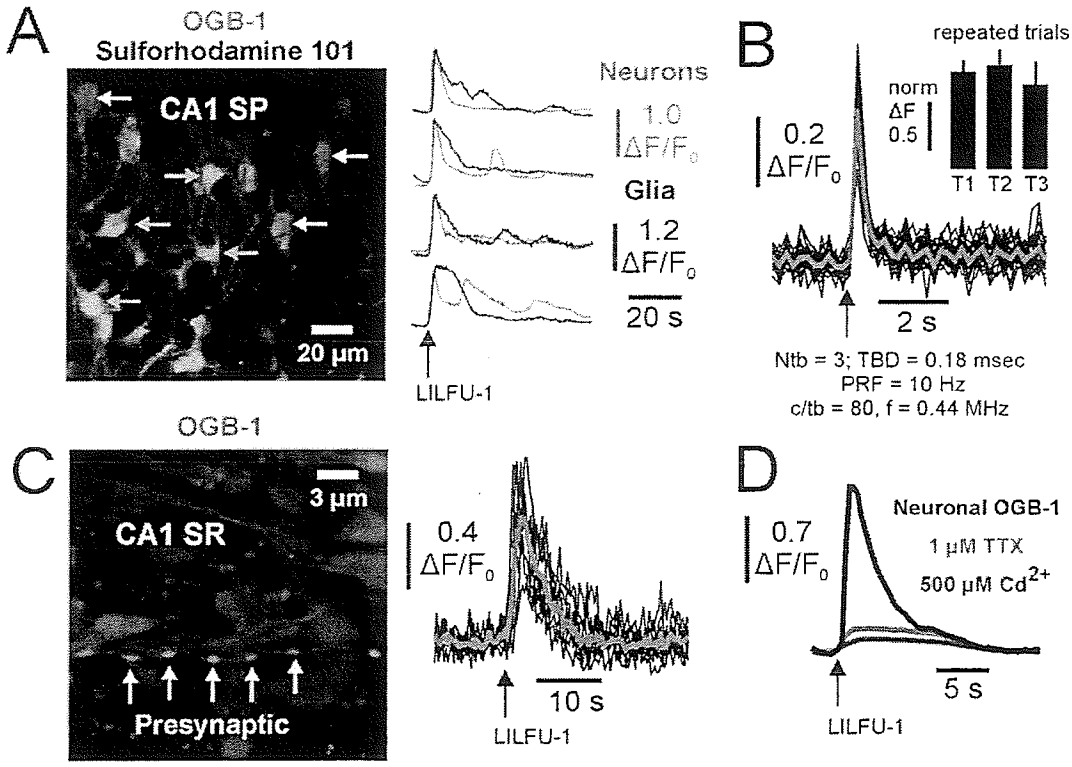

Figure 3. LILFU triggers voltage-dependent somatic and presynaptic Ca^{2+} transients in neurons. (A) Confocal image (*left*) of a slice culture loaded with OGB-1 AM (*green*) to monitor Ca^{2+} activity and Sulforhodamine 101 (*red*) to identify glial cells (*yellow*). Representative LILFU-triggered Ca^{2+} transients observed in the somas of neurons and glial cells are illustrated (*right*). (B) Individual (*black*) and averaged (*green*) Ca^{2+} transients observed in the somas of neurons in response to a brief LILFU waveform. The histogram (*inset*) illustrates trial 1 normalized mean Ca^{2+} transient amplitudes in response to repeated trials of LILFU stimulation (n = 19 cells from 3 slices). (C) Confocal image (*left*) of a slice culture loaded with OGB-1 AM illustrating *en passant* boutons located in CA1 SR. Individual (*black*) and averaged (*green*) presynaptic Ca^{2+} transients (*right*) produced by stimulation with LILFU-1. (D) Averaged somatic Ca^{2+} transients obtained from neurons under control conditions or in the presence of either TTX (n = 36 from 4 slices) or Cd^{2+} (n = 30 from 4 slices) in response to stimulation with LILFU-1.
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receptors, which is consistent with both channels possessing mechanosensitive properties [31,32] and being expressed in hippocampal neurons.

We were able to observe Ca^{2+} transients in response to pulsed US even when transducers were placed as far as 45 mm away from slices (n = 5; data not shown). Similar to water and aqueous buffers, soft biological tissues (including brain) have relatively low acoustic absorption coefficients. Therefore, we sought to determine if LILFU propagated through whole brain tissue was also capable of stimulating neuronal activity. We imaged OGB-1 signals on the dorsal superficial surface of *ex vivo* brains (n = 3) obtained from wild-type adult mice while transmitting LILFU waveforms through their ventral surfaces (Figure 4A). In these *ex vivo* brain preparations, we observed Ca^{2+} transients similar to those observed in thinner and less intact slice culture preparations in response to stimulation with LILFU (Figure 4B, 4C).

LILFU triggers SNARE-mediated synaptic vesicle exocytosis and synaptic transmission

To investigate the influence of LILFU on synaptic transmission we focused on studying a well-characterized synapse in the mammalian central nervous system, the hippocampal CA3-CA1 synapse. We transmitted LILFU waveforms through hippocampal slice cultures prepared from *thy-1*-synaptopHluorin (spH) mice [33]. The pH-dependent optical probe of synaptic vesicle exocytosis spH reflects neurotransmitter release through an increase in fluorescence when protons are released from synaptic vesicles during fusion [34]. Transmission of LILFU-1 through slices triggered synaptic vesicle exocytosis producing a ΔF_{spH} of 18.52±2.2% at individual release sites (n = 148 from 15 slices) in CA1 *stratum radiatum*, which primarily represent CA3-CA1 synapses (Figures 5A, 5B and Video S2). We identified several other LILFU waveforms, which were also effective at triggering synaptic vesicle release (Table S1). For example, a LILFU waveform composed of different US tone bursts (f = 0.67 MHz, TBD = 74.5 msec, c/tb = 50,000; Figure 5C) delivered at PRF = 10 Hz with Ntb = 5 also stimulated synaptic vesicle release (ΔF_{spH} = 12.86±2.6%, n = 74 from 6 slices; Figure 5D). Figure 5E illustrates spH responses obtained as a function of acoustic intensity across several different LILFU waveforms used in this study. To more specifically examine excitatory CA3-CA1 hippocampal synapses, we implemented a DiOlistic labeling approach [35] to visualize dendritic spines on CA1 apical dendrites in *thy-1*-spH slices cultures. Indeed, LILFU-1 stimulated synaptic vesicle release in this population of spine synapses (Figure 6).

Hyperosmotic shock produced by application of sucrose to hippocampal synapses is capable of stimulating the release of a small pool of primed synaptic vesicles (~10 vesicles) in a Ca^{2+}-independent manner and is thought to occur from mechanical processes [36]. Due to the nature of mechanical energy conferred

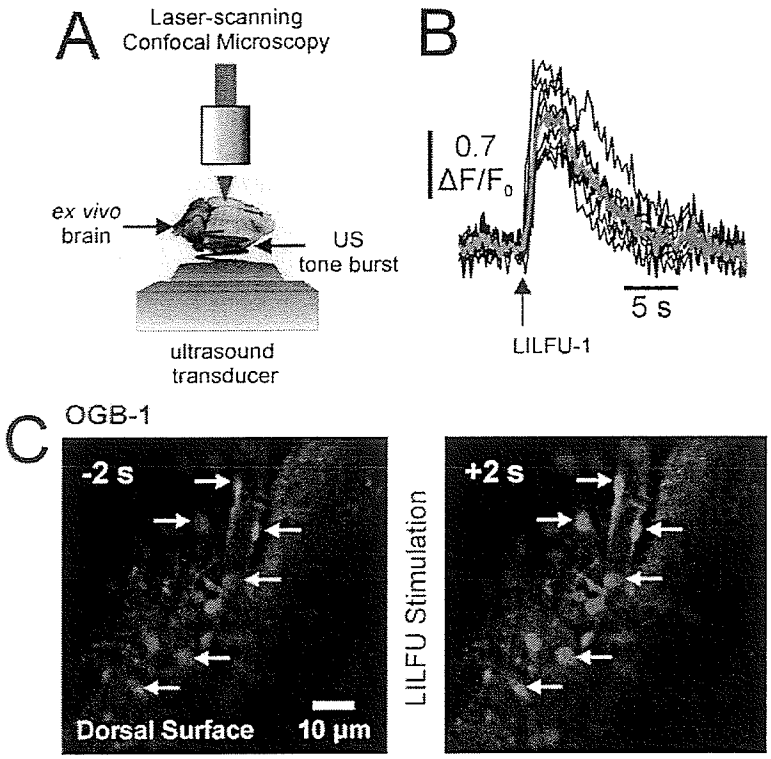

Figure 4. LILFU waveforms transmitted through whole brains are capable of stimulating calcium transients. (A) Illustration of basic experimental procedure we developed to transmit LILFU waveforms through whole *ex vivo* brains prepared from adult wild-type mice and bath-loaded with OGB-1 AM. As depicted, LILFU waveforms were transmitted from the ventral surface of the brain through the tissue to the dorsal surface where we performed confocal imaging. (B) Individual (*black*) and averaged (*green*) Ca^{2+} transients observed in the somas of cells on the dorsal surface of an *ex vivo* brain in response to stimulation with LILFU-1, which was transmitted through the brain from the ventral surface. (C) Confocal images illustrating OGB-1 loaded cells on the dorsal surface of the brain. The image on *left* illustrates cells during baseline, while the image on the *right* illustrates cells two-seconds after stimulation with LILFU-1 ensued.
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by acoustic waves, we questioned whether some part of the synaptic vesicle release we observed in response to LILFU might be due to mechanical interactions on vesicle release machinery or between the lipid bilayers of active zones and synaptic vesicles. Since hypertonic sucrose application is still capable of triggering neurotransmitter release at hippocampal synapses lacking the SNARE-protein SNAP-25 [37], we aimed to determine if LILFU-1 was capable of stimulating neurotransmitter release after cleaving SNAP-25 by treating slice cultures with botulinum neurotoxin type-A (BoNT/A; 24–36 h). Indicating that pulsed US-induced exocytosis is SNARE-mediated and not likely due to mechanisms similar to those produced by hyperosmotic shock, treatment of slice cultures with BoNT/A nearly abolished spH responses produced by LILFU-1 stimulation (Figure 5F).

Addition of TTX almost completely blocked vesicular release in response to LILFU-1 highlighting the importance of Na^+ conductance and action potentials in LILFU-triggered synaptic vesicle release (Figure 5F). Blocking excitatory network activity with CNQX (20 μM) and APV (100 μM) reduced the ΔF_{spH} by ~50% compared to controls indicating that LILFU stimulates synaptic transmission (network activity) and not merely exocytosis (Figure 5F). Interestingly, the kinetics and amplitudes of LILFU-triggered spH signals were nearly identical to those obtained in response to electrical stimulation of CA3 Schaffer collaterals using monopolar electrodes (Figure 5G), as well as those spH responses previously reported [33,38]. Since spH typically produces a ΔF of ~1–2% per released vesicle [38,39], we estimated LILFU-1 to stimulate the release of ~15 vesicles per release site.

Discussion

In this study we tested whether LILFU was capable of directly stimulating the activity of neurons in the central nervous system. We made several novel observations in our study. From a mechanistic view, we observed that US stimulates neuronal activity at least partially by triggering voltage-gated Na^+ transients and voltage-dependent Ca^{2+} transients. We further observed the US-induced changes in neuronal activity were sufficient to trigger SNARE-mediated synaptic vesicle exocytosis and synaptic transmission at central synapses thereby driving network activity.

The mechanisms underlying US activation of voltage-sensitive channels in neurons are presently unknown. We postulate however the mechanical nature of US and its interactions with neuronal membranes leads to the opening of mechanically sensitive voltage-gated channels. Supporting this hypothesis, we observed that TTX a voltage-gated Na^+ channel pore-blocker attenuated LILFU-triggered Na^+ transients. Further, many voltage-gated Na^+ channels (i.e. NaV 1.2, 1.4, 1.5, and 1.6) are known to possess varying degrees of mechanical sensitivity [16,17]. The addition of TTX also blocked a large portion of LILFU-induced Ca^{2+} transients indicating the primary action of LILFU may be on voltage-gated Na^+ channels. However, the addition of Cd^{2+} further reduced LILFU-activated

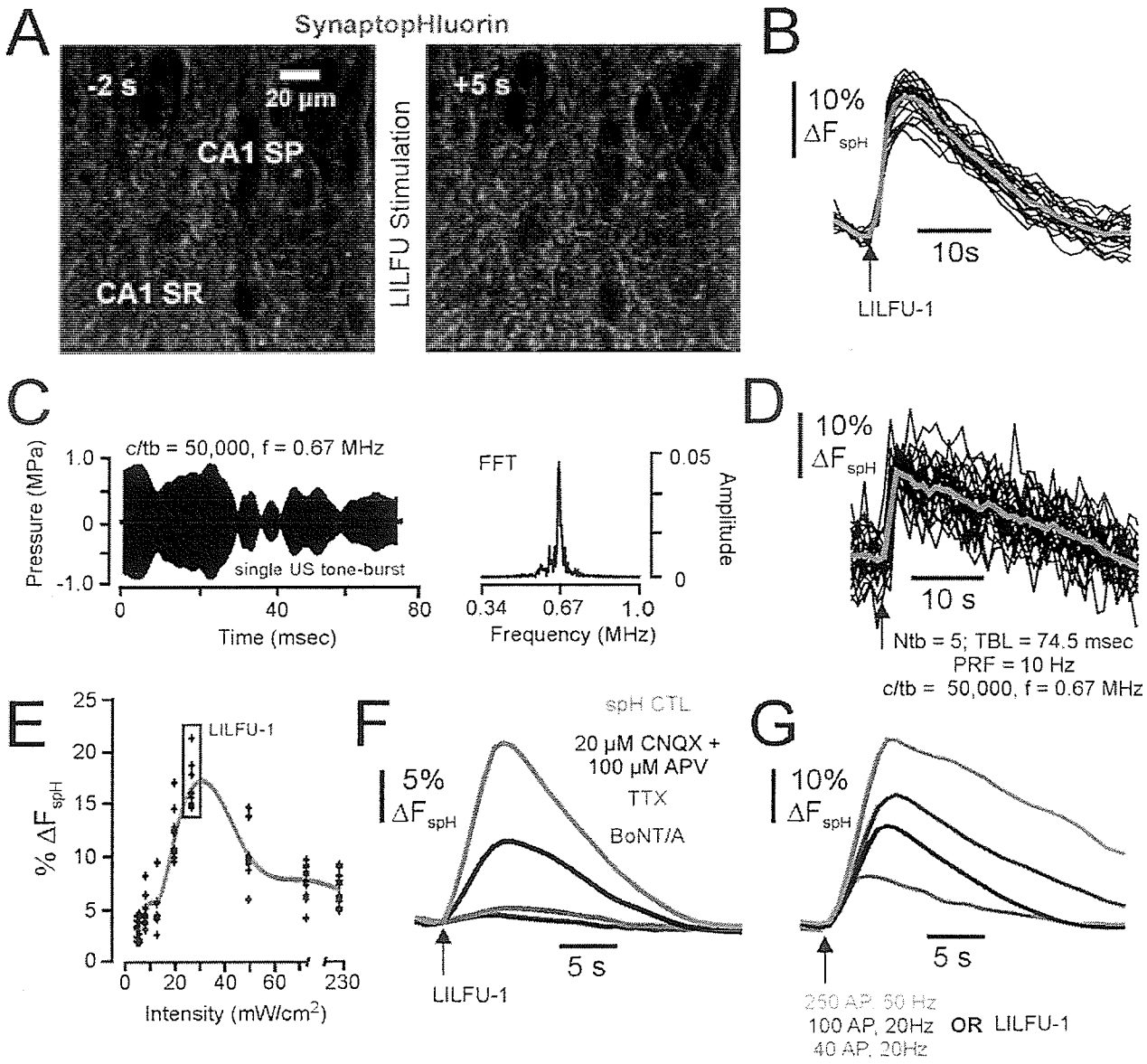

Figure 5. LILFU stimulates SNARE-mediated synaptic vesicle exocytosis and central synaptic transmission. (A) Confocal images illustrating spH signals obtained before (*left*) and during (*right*) stimulation with LILFU-1. (B) Individual (*black*) and averaged (*green*) spH signals typically obtained in response to stimulation with LILFU-1. (C) Acoustic pressure wave (*left*) produced by a single LILFU tone burst consisting of 50,000 acoustic cycles at f = 0.67 MHz and FFT of LILFU tone burst (*right*). (D) Individual (*black*) and averaged (*green*) spH signals obtained in response to stimulation with the LILFU tone burst shown in (C) delivered at a PRF = 10 Hz for 0.5 s to produce Np = 5. (E) Histogram of spH responses obtained as a function of acoustic intensity. Responses from individual experiments are indicated by *black crosses* while the average response is indicated by the *green line*. (F) Averaged spH signals illustrating the effect of CNQX+APV (n = 84 from 4 slices), TTX (n = 108 from 4 slices), or BoNT/A (n = 60 from 4 slices) on synaptic vesicle exocytosis induced by LILFU-1. (G) Averaged spH signals obtained from buttons in response to field stimulation of Schaffer collaterals with 250 AP, 50 Hz (n = 48), 100 AP, 20 Hz (n = 63), 40 AP, 20 Hz (n = 51), or by LILFU-1 (n = 148).
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Ca^{2+} transients, which suggests at least some voltage-gated Ca^{2+} channels may be sensitive to LILFU. Indeed, L-type, N-type, T-type, and P-type Ca^{2+} channels have been shown to be mechanically sensitive under various conditions [16,17].

Further studies are required to identify which ion channels are sensitive to US, as well as to characterize how these channels respond to US as a function of acoustic intensity. By imaging large fields of view and monitoring the responses from large populations of neurons, we observed that LILFU-1 stimulated activity in ~30% of the neurons in a given field. These observations raise several interesting issues. We question for instance whether neurons, which have been recently active, are less susceptible to US stimulation. In other words, the kinetic states of a neuron's ion channels may shape how responsive a given cell is to US stimulation. It could also be the case that recently active neurons are more responsive to US stimulation. We are currently in the process of investigating these issues. The individual properties of US waveforms (peak and temporal average intensity, tone burst/

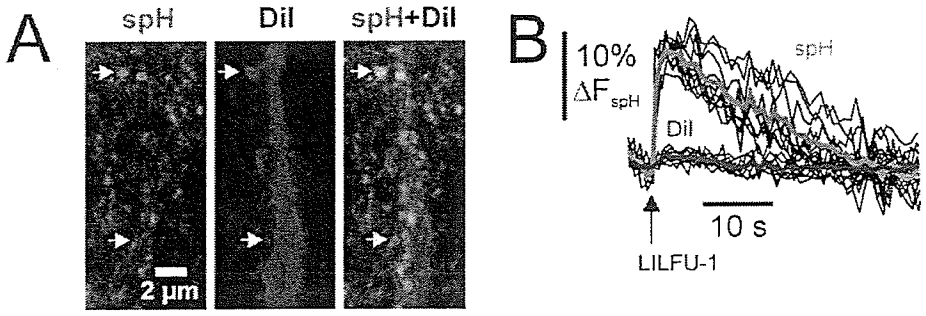

Figure 6. Influence of LILFU on putative excitatory hippocampal CA3-CA1 synapses. (*A*) Confocal images illustrating spH expression in CA1 SR (*left*) and an apical dendritic branch of a CA1 pyramidal neuron, which was labeled with DiI using a DiOlistic labeling technique (*middle*). The two-channel confocal image (*right*) illustrates putative excitatory synapses indicated by apposition of spH^+ puncta and dendritic spines. (*B*) Individual (*black*), mean spH (*green*), and mean DiI (*red*) signals obtained from terminals impinging on dendritic spines in response to stimulation with LILFU-1.
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pulse duration, pulse repetition frequency, etc.) will also likely determine how effective a given waveform is at stimulating neuronal activity. With respect to acoustic intensity for example, we observed that US waveforms having moderate intensities were more robust in triggering synaptic transmission compared to US waveforms possessing lower or higher intensities. Future studies investigating the influence of US on neuronal activity should consider interactions among waveform parameters such as tone-burst duration (pulse length), pulse repetition frequency, exposure time, acoustic frequency, and acoustic intensity. Understanding how waveform characteristics contribute to the actions of US on neuronal activity will be an important issue to resolve. One particularly interesting question is can LILFU be used in a molecularly specific manner–perhaps by inducing protein specific resonances using an optimal acoustic frequency or particular LILFU waveform?

Potential biohazardous effects of US

Having a long and proven safety record, US is widely used for diagnostic medical imaging, as well as in an array of noninvasive therapies [13]. Ultrasound is however quite capable of destroying biological tissues, so when employing US to stimulate neuronal activity the potential for biohazardous effects must be carefully considered. Many of the hazards associated with US stem from its ability to induce large thermal fluctuations and/or cavitational damage in soft tissues. Although many groups have previously demonstrated an effect of US on neuronal activity [3,4,18–24], these results are unique in that we found US is capable of stimulating neuronal activity at lower acoustic intensities than those previously reported. Some groups have utilized acoustic intensities as low as 1 W/cm^2 to modulate neuronal activity in hippocampal brain slices [19], whereas other groups have used intensities exceeding 1000 W/cm^2 to trigger peripheral pain sensations in humans [3]. In this study we implemented a range of acoustic intensities where the nonthermal effects of US have been well documented in other tissues (30–500 mW/cm^2) [5,11–13]. Further, the US intensities we found sufficient for stimulating neuronal activity are below the output power limits set by the United States Food and Drug Administration for diagnostic imaging.

Due to the lack of gas bodies in most soft tissues including brain [13], we do not expect cavitation to pose significant problems when using LILFU to stimulate brain activity *in vivo*. In most soft tissues, cavitation rarely induces damage at pressures <40 MPa (except for lung, intestinal, and cardiac tissues in which cavitational damage can occur at pressures ~2 MPa due to the presence of naturally occurring gas bodies) [13]. The peak rarefactional pressure used in our studies was <1 MPa. At the US power levels we studied, cavitational damage was not induced in hippocampal slice cultures. Besides the potential biohazards of acute US transmission into brain tissue, the possibility for damage arising from repeated, long-term US exposure needs to be evaluated. Few studies have examined the effects of chronic US administration on brain function. We found that chronic LILFU stimulation (36–48 h) did not alter the fine structure of neuronal membranes. Demonstrating the need for caution however, a recent study reported that repeated US exposure is capable of producing some disruption of neuronal migration in the cortex of developing mouse embryos [40].

The effects of US on molecular signal transduction pathways

While we have studied the actions of US on neuronal activity by monitoring ionic conductance and synaptic vesicle exocytosis, we recognize US may influence signaling molecules capable of influencing neuronal function. In other tissues, the activity of several signaling molecules also present in neuronal tissues are known to be influenced by US. For example, low-intensity pulsed US stimulates TGF-β signaling, which triggers the differentiation of human mesynchymal stem cells into chondrocytes [41]. Low-intensity pulsed US has also been shown to stimulate the production of bFGF, TGF-β, BMP-7, VEGF, and IGF-1 [42–45]. Certainly bFGF, TGF-β, BMP-7, VEGF, and IGF-1 have differential yet significant effects on the nervous system by affecting processes involved in synaptic transmission, neuronal growth/survival [46,47], cell fate specification, tissue patterning, axon guidance in the nervous system [48], and angiogenesis in the brain [49]. Moreover, VEGF [49,50], TGF-β [51,52], and bFGF [46] are neuroprotective against hypoxic-ischemic injury and neurodegeneration. These observations prompt the intriguing question of whether it is possible for US to trigger these pathways in the brain or the production and secretion of growth factors such as brain-derived neurotrophic factor, neurotrophin-3, or nerve growth factor.

Additional actions on conserved cell signaling pathways further support explorations into the use of US as a neuromodulation tool. NF-κB is known to regulate neuronal survival and plasticity [53]. Integrin-linked kinase (ILK) and Akt are known to be important signals in establishing neuronal polarity [54]. The PI3K-Akt signaling pathway is capable of blocking cell death and promoting cell survival of many neuronal cell types [55]. Ultrasound induces cyclooxegynase-2 expression in human chondrocytes by activating the integrin/ILK/Akt/NF-κB/ and p300 signaling pathway [56],

while in murine osteoblasts US stimulates COX-2 expression via the integrin/FAK/PI3K/Akt and ERK signaling pathway [57]. It should be determined if US is also capable of stimulating ILK, PI3K, Akt, and or NF-κB signaling in neurons as these signaling molecules may become important targets for future ultrasonic neuromodulation strategies.

Feasibility of delivering LILFU to intact nervous systems and brains for neuromodulation

As a tool for modulating neuronal function, US has been studied and considered across a range of uses from thermal ablation of nervous tissues to its ability to produce sensory perceptions [6,9,10]. Gavrilov and colleagues (1976) were the first to show that US is capable of activating both superficial and deep peripheral nerve structures in humans, which lead to different thermal, tactile, and pain sensations. In these studies however, US was only transmitted through soft tissues such as the skin to stimulate neuronal activity. Whether US will be effective in the noninvasive transcranial regulation of neuronal circuits in the intact nervous system remains to be determined.

Transcranial ultrasonography of the basilar artery has been shown to trigger auditory sensations in human subjects [58]. Other studies have reported similar observations in animals during delivery of transcranial US and at least one underlying mechanism is thought to involve the direct stimulation of auditory nerve fibers by US [10]. Collectively, these observations demonstrate transcranial US is capable of evoking sensory stimuli even in humans. Despite these exciting observations, the skull is a major obstacle when considering the transmission of US into intact brains for neurostimulation purposes. The skull reflects, refracts, absorbs, and diffracts US fields. Acoustic impedance mismatches between the skin, skull, and skull-brain interfaces also present a challenge for transmitting US through the skull into the intact brain. The frequency of US we chose for the construction of LILFU waveforms (0.44–0.67 MHz) represents a range where optimal gains have been previously reported between transcranial US transmission and brain absorption. Based on modeling data of transmission and attenuation coefficients, as well as experimental data examining the transmission of US through *ex vivo* human skulls, the optimal gain for the transcranial US transmission and brain absorption is between 0.60 and 0.70 MHz [25,26]. Based on our observations and the findings of others, it is likely that LILFU fields can be transmitted through skulls into the intact brain for gross neurostimulation purposes similar to methods using rTMS. In order to achieve targeted neurostimulation however, it will be necessary to focus LILFU fields.

It is possible to focus US fields using a variety of approaches. Pulsed US (<1 MHz) can be focused through human skulls to points within 1 mm of intended loci using phased US transducer arrays [6,8,59]. Based on observations reported in studies designed to investigate US field focusing through human skulls [6,8,59], US may be able to confer a spatial resolution similar to those achieved by currently implemented neuromodulation strategies such as vagal nerve stimulation and DBS, which have been shown to possess high therapeutic value [1,60]. Before the feasibility of using focused LILFU for targeted neurostimulation purposes can be properly determined, future studies must directly address how focused US fields influence the activity of neuronal populations *in vivo*.

Conclusions

Our observations demonstrate that LILFU can be used to remotely stimulate the activity of central nervous system neurons and circuits *in vitro*. We have provided the first direct evidence that US modulates the ionic conductance of neurons and astrocytes to increase cellular activity and synaptic transmission in a manner sufficient to stimulate neuronal circuits. Several issues need to be resolved before the full potential of US in controlling neuronal activity can be realized. Since US is capable of being focused through the human skull however, one tantalizing possibility is that LILFU may permit deep-brain stimulation without the need for surgically implanted devices or other invasive procedures.

Materials and Methods

Preparation of slice cultures and *ex vivo* brains

All procedures involving mice were conducted in accordance with federal guidelines and protocols approved by the Institutional Animal Care and Use Committee at Arizona State University. Hippocampal slice cultures were prepared from postnatal day 7–8 *thy-1*-spH, *thy-1*-YFP, or wild-type mice similar to previously described methods [61]. Briefly, transverse hippocampal slices (~400 μm thick) were made using a wire slicer (MX-TS, Siskiyou, Inc., Grants Pass, Oregon, USA) and maintained *in vitro* on Millicell-CM filter inserts (PICMORG50, Millipore, Bedford, MA) in a 36°C, 5% CO_2, humidified (99%) incubator. Slices were used for experiments between 7 and 12 days *in vitro*. In some experiments to cleave SNARE-proteins, BoNT/A (250 ng/mL) was added to the slice culture media 24–36 h prior to use.

We prepared *ex vivo* brains using the following approach. Following CO_2 inhalation, wild-type mice were rapidly decapitated and their brains were removed. The dura was carefully removed and the brains were then placed in ice-cold artificial CSF (aCSF) containing (in mM) 83 NaCl, 2.5 KCl, 3.3 $MgSO_4$, 1 NaH_2PO_4, 26.2 $NaHCO_3$, 22 glucose, 72 sucrose, and 0.5 $CaCl_2$, and equilibrated with 95% O_2/5% CO_2. Brains were allowed to recover for 5 min in the ice-cold aCSF before recovering for ~20 min at 37°C. Following this recovery period, *ex vivo* brains were bulk loaded with OGB-1 AM (Invitrogen, Carlsbad, California, USA).

Loading of slice cultures and *ex vivo* brains with fluorescent ion indicators

In order to load slice cultures prepared from wild-type mice with CoroNa Green AM (Invitrogen, Carlsbad, California, USA), 5 μL 20% Pluronic F-127 in DMSO (Invitrogen) was added to a 50 μg vial of CoroNa Green AM. The dye solution was then vortexed for 15 min before adding 100 μL culture medium. We then added 5 μL of the dye-containing solution to 1 mL culture medium underneath culture inserts, as well as adding 5 μL to the surface of slices. Following a 10 min incubation time at 36°C, slices were washed three times with slice culture medium, allowed to recover an additional 10 min, and then used for experiments. To load slice cultures with OGB-1 AM, we added 2 μL 20% Pluronic F-127 in DMSO and 8 μL DMSO to a 50 μg vial of OGB-1 AM. The dye-containing solution was then vortexed for 30 M before adding 90 μL culture media. We next added 20 μL of this dye-containing solution to 3 mL culture medium and incubated slices in this solution for 30–40 min at 37°C. Slices were washed three times with slice culture medium, then loaded with sulforhodamine 101 (Invitrogen; 10 μM in slice culture medium for 15 min) or allowed to recover for 30 min prior to an experiment. To load *ex vivo* brains with OGB-1 AM we used a procedure similar to above, but substituted the slice culture medium for dissection aCSF (see above)–we added 60 μL of the dye-containing solution to 9 mL dissection aCSF. Brains were loaded for 30 min at room temperature then rinsed three times and allowed to recover for an additional 30 min in dissection aCSF at room temperature before use.

Confocal imaging and whole-cell patch-clamp recordings

Slice cultures or whole *ex vivo* brains were transferred to recording chambers containing recording aCSF (in mM) 136 NaCl, 2.5 KCl, 1.3 $MgSO_4$, 10 HEPES, 10 glucose, and 2.5 $CaCl_2$, pH 7.4 at room temperature. Recording chambers were affixed above US transducers on a custom built-stage on an Olympus Fluoview FV-300 laser-scanning confocal microscope (Olympus America, Inc., Center Valley, Pennsylvania, USA). Excitation of spH, OGB-1 AM, and CoroNa Green AM was performed using the 488 nm laser-line of an argon laser and in some experiments DiI was excited using a 546 nm HeNe laser. Time-series images were acquired using 20×(0.5 NA) or 40×(0.8 NA) Olympus UMPlanFL water-immersion lens.

Slice recording chambers consisted of culture inserts placed inside an aCSF reservoir held in place with either vacuum grease on the silicon face of the transducer. This approach produced ~4.5 mm standoff distance between the face of the transducer and the imaging plane on the surface of slices. In a subset of experiments, slice cultures (n = 5) were mounted near the top of an aCSF column in a 500 mL beaker containing immersed US transducers, which were affixed to the bottom beakers to provide a 45 mm standoff distance. To image *ex vivo* brains, the ventral surface of whole *ex vivo* brains were glued to the bottom of polystyrene 6-well plates using superglue, which were filled with aCSF and mounted above US transducers using ultrasonic coupling gel. Confocal imaging of OGB-1 fluorescence was conducted on the superficial dorsal surface of *ex vivo* brains during transmission of LILFU waveforms from the ventral surface of the brain.

In a subset of experiments we performed whole-cell current clamp recordings from visually identified CA1 pyramidal neurons using standard approaches. Briefly, patch electrode pipettes filled with an intracellular solution containing (in mM) 130 KCl, 10 Na-HEPES, 10 Di-Tris-P-creatine, 0.2 EGTA, 3 Mg-ATP, and 0.5 Na-GTP, 280–290 mOsm, pH 7.2; the final resistance of these unpolished patch electrodes was 5–7 MΩ. Current clamp recordings were performed using a MultiClamp 700B patch-clamp amplifier with pCLAMP 10 software (Molecular Devices, Sunnyvale, California, USA). Following 5–10 min of whole-cell access, changes in membrane voltage were recorded in response to stimulation with LILFU waveforms.

Generation and characterization of LILFU waveforms

In our studies we used custom built PZT ultrasound transducers (d = 35 mm) having a single quarter-wave matching layer, a center frequency of 0.53 MHz, and a −6 dB fractional bandwidth of 65% with two peaks (0.44 MHz, 0.66 MHz). LILFU waveforms used as stimuli were generated by repeating pulse trains of US tone bursts at a pulse repetition frequency until a desired number of tone bursts had been generated (Figure 1B). Ultrasound tone bursts were generated by trains of square waves (0.2 μsec) with variable amplitudes (Table S1) using an Agilent 33220A function generator. To produce final plate voltages delivered to transducers, square waves were further amplified (50 dB gain) using an ENI 240L RF amplifier. Square waves were delivered between 0.44–0.67 MHz depending on the acoustic frequency desired, while the number of square waves driving each US tone burst equaled the number of acoustic cycles desired for a given US tone burst. Each US tone burst (pulse) contained between 1 and 50,000 acoustic cycles depending on the LILFU waveform generated. US tone bursts (Figure 1B) were repeated at a pulse repetition frequency by triggering the above referenced function generator with a second Agilent 33220A function generator. Pulse repetition frequencies were either a constant frequency or a swept waveform. Our primary LILFU waveform (LILFU-1) had the following properties: f = 0.44 MHz, TBD = 22.7 μs, c/tb = 10, PRF = 5 sec sweep 0–100 Hz, and Ntb = 250.

To characterize LILFU power levels, we recorded voltage waveforms produced by US pressure waves using a hydrophone (HNR 500, Onda Corporation, Sunnyvale, California, USA) and an Agilent DSO6012A 100 MHz digital oscilloscope (Agilent Technologies, Inc., Santa Clara, California, USA). To confirm transducers were operating at the intended acoustic frequency, we performed an FFT on hydrophone voltage traces recorded in response to US tone bursts. All pressure waves produced by LILFU waveforms were measured at points corresponding to tissue positions in the actual recording chambers by positioning the hydrophone face using a *xyz* micromanipulator (MP-225, Novato, CA, USA) mounted on the vibration isolation table attached to the microscope stage (Figure S1). The position of slices in recording chambers was held consistent across experiments. We measured acoustic intensities with and without slices in the recording chamber and found no effect of the presence of a slice on the acoustic waveform. The acoustic pressure and ultrasonic intensities ($I_{P.A}$ and $I_{T.A}$) were calculated using published equations and technical standards established by the American Institute of Ultrasound in Medicine and the National Electrical Manufacturers Association [62].

Data analysis

Confocal images were analyzed offline using *ImageJ* (http://rsb.info.nih.gov/ij/) or the Olympus Fluoview 5.0 software. We express changes in spH fluorescence as a percent change from baseline fluorescence levels. For OGB-1 and CoroNa Green signals, we calculated $\Delta F/F_0$ using standard approaches where $\Delta F = F - F_0$. LILFU waveforms and electrophysiological analyses were performed offline using *Igor Pro* (WaveMetrics, Lake Oswego, Oregon, USA). Data shown are mean±S.E.M.

Supporting Information

Figure S1 Characterization and operation of PZT transducers. Illustration of experimental setup used to operate PZT transducers and transmit LILFU waveforms through neuronal tissue. For measuring PZT properties, as well as the pressure waves produced by US tone bursts, we used a calibrated hydrophone. To investigate the influence of LILFU on neuronal activity, we transmitted LILFU waveforms through a column of aCSF into hippocampal slice cultures while simultaneously performing confocal microscopy (see *Materials and Methods* for further details).
Found at: doi:10.1371/journal.pone.0003511.s001 (2.80 MB TIF)

Table S1
Found at: doi:10.1371/journal.pone.0003511.s002 (0.05 MB DOC)

Video S1 The video illustrates a time-lapsed series of confocal images obtained from an organotypic slice culture prepared from a wild-type mouse, which was bath-loaded with OGB-1 AM. Hippocampal CA1 *stratum pyramidale* is indicated. The appearance of *red* stim indicates the delivery of LILFU-1. As indicated by the increase in OGB-1 fluorescence intensity, Ca2+ transients were triggered in response to stimulation with LILFU-1.
Found at: doi:10.1371/journal.pone.0003511.s003 (7.87 MB AVI)

Video S2 The video illustrates a time-lapsed series of confocal images obtained from a thy-1-spH organotypic slice culture. Hippocampal CA1 *stratum pyramidale* is in the upper left region of the movie with the proximal portion of *stratum radiatum* emerging towards the lower right quadrant of the movie. The appearance of *red* stim indicates the delivery of LILFU-1. As indicated by the

increase in spH fluorescence intensity, the induction of vesicle release in response to LILFU can be clearly resolved at individual buttons. Found at: doi:10.1371/journal.pone.0003511.s004 (7.56 MB AVI)

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Author Contributions

Conceived and designed the experiments: WJT. Performed the experiments: WJT YT MF MLT EJO. Analyzed the data: WJT YT MLT EJO CM. Contributed reagents/materials/analysis tools: WJT MF. Wrote the paper: WJT YT MLT EJO.

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EXHIBIT 3

Other Information

Armed With Science: The Official U.S. Defense Department Science Blog
Remote Control of Brain Activity Using Ultrasound

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Remote Control of Brain Activity Using Ultrasound

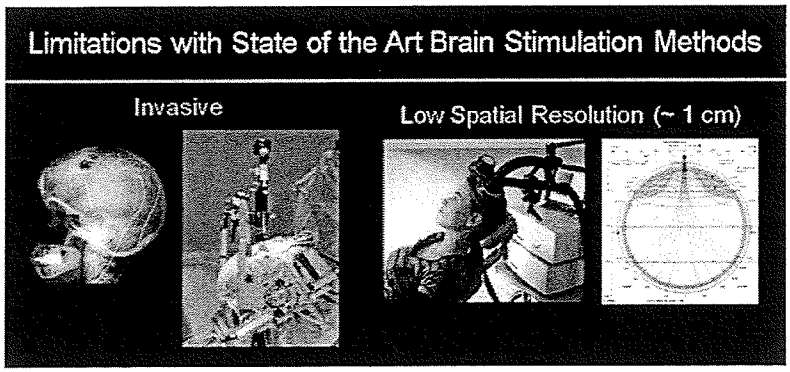
Posted on September 1, 2010 by Armed with Science

Dr. William J. Tyler is an Assistant Professor in the School of Life Sciences at Arizona State University, is a co-founder and the CSO of SynSonix, Inc., and a member of the 2010 DARPA Young Faculty Award class.

Every single aspect of human sensation, perception, emotion, and behavior is regulated by brain activity. Thus, having the ability to stimulate brain function is a powerful technology.

Recent advances in neurotechnology have shown that brain stimulation is capable of treating neurological diseases and brain injury, as well as serving platforms around which brain-computer interfaces can be built for various purposes. Several limitations however still pose significant challenges to implementing traditional brain stimulation methods for treating diseases and controlling information processing in brain circuits.

For example, deep-brain stimulating (DBS) electrodes used to treat movement disorders such as Parkinson's disease require neurosurgery in order to implant electrodes and batteries into patients. Transcranial magnetic stimulation (TMS) used to treat drug-resistant depression and other disorders do not require surgery, but have a low spatial resolution of approximately one centimeter and cannot stimulate deep brain circuits where many diseased circuits reside.



These illustrations show the surgical invasiveness of deep-brain stimulating electrodes (left) and depict the low spatial resolutions conferred by transcranial magnetic stimulation (right). (Image: Tyler Lab)

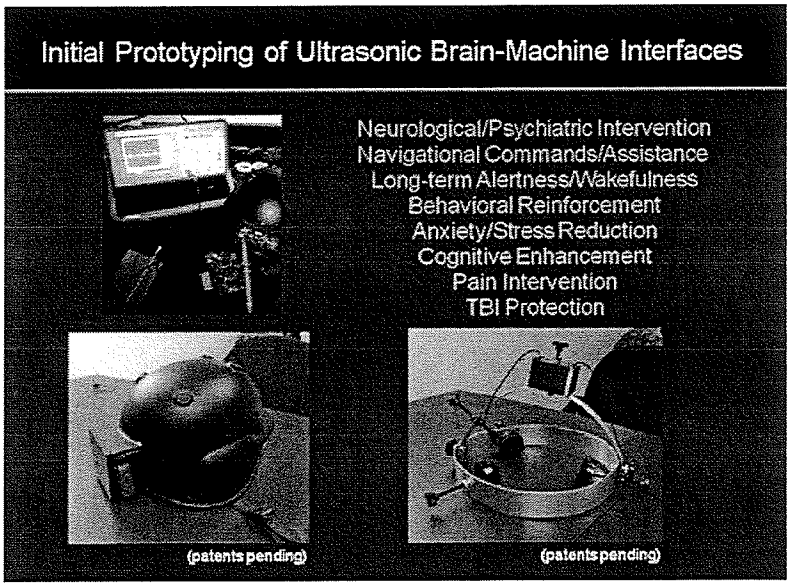
To overcome the above limitations, my laboratory has engineered a novel technology which implements transcranial pulsed ultrasound to remotely and directly stimulate brain circuits without requiring surgery. Further, we have shown this ultrasonic neuromodulation approach confers a spatial resolution approximately five times greater than TMS and can exert its effects upon subcortical brain circuits deep within the brain.

A portion of our initial work has been supported by the U.S. Army Research, Development and Engineering Command (RDECOM) Army Research Laboratory (ARL) where we have been working to develop methods for encoding sensory data onto the cortex using pulsed ultrasound.

Through a recent grant made by the Defense Advanced Research Projects Agency (DARPA) Young Faculty Award Program, our research will begin undergoing the next phases of research and development aimed towards engineering future applications using this neurotechnology for our country's warfighters. Here, we will continue exploring the influence of ultrasound on brain function and begin using transducer phased arrays to examine the influence of focused ultrasound on intact brain circuits. We will also be investigating the use of capacitive micromachined ultrasonic transducers (CMUTs) for use in brain stimulation. Finally, to improve upon spatial resolution, we will examine the use of acoustic metamaterials and hyperlenses to study how subdiffraction limited ultrasound influences brain wave activity patterns.

How can this technology be used to provide our nation's Warfighters with strategic advantages? We have developed working and conceptual prototypes in which ballistic helmets can be fitted with ultrasound transducers and microcontroller devices to illustrate potential applications as shown below.

We look forward to developing a close working relationship with DARPA and other Department of Defense and U.S. Intelligence Communities to bring some of these applications to fruition over the coming years depending on the most pressing needs of our country's defense industries.



Above illustrations show a ballistic helmet fitted with four ultrasound transducers (left) and another functional prototype for achieving human brain stimulation using a single element transducer (bottom-right), as well as a list of potential applications relevant to the defense industry. (Image: Tyler Lab)

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This entry was posted in Life Sciences, Physical Sciences, Technology, Videos and tagged Arizona State University, DARPA, dbs, deep-brain stimulation, Defense Advanced Research Projects Agency, Dr. William Tyler, tms, Transcranial magnetic stimulation, ultrasound. Bookmark the permalink.

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john anthony pattison

this technology could be good at quickly bringing the those with this technology into hypnotic trance as a way to access anything from their unconscious photographic memory... however, i am opposed to this system being used all the time on the citizens brain... as humans our bodies react to oppose all changes to our system...so if this system was used all the time on our brains then our brains would become reliant on this system in much the same way citizens need their coffee to function each day... so at firts (1st) the citizen doesn't need the coffee but with prolonged use they do need it because their body naturally slows down [after the coffee is out of their system] in response to continued stimulation from coffee... that is, in much the same way that if you have an oily face and use soap on your face everyday for a week and then suddenly stop the soap... well, your face will then soon get more oily than it was before the soap treatment began...

i have heard that some illegal drugs can create permanent changes to the brains of those who use them... i think this system has much use to enable citizens to quickly access the their unconscious mind and its photographic memory at key times... i think this system also may be useful to give someone a quick topup to get into peak state say once a month or every few months but using it every day to keep in peak state i think is too much and will cause damage and dependance... i also think that more research needs to be conducted as to how certain illegal drugs can create permanent changes in their users... it may be hard to get ethics approval to test new chemical componds on drug addicts when they think they are - perhaps - just getting some more of there regular drugs... they would be loyal to their drug dealer

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Weird Science **4:25** PM TUE AUGUST 27, 2013

UW Researchers Use Brain of One to Control Body of Another

By GABRIEL SPITZER (/PEOPLE/GABRIEL-SPITZER)

(http://mediad.publicbroadcasting.net/p/kplu/files/styles/placed_wide/public/201308/Screen_Shot_2013-08-27_at_4.22.11_PM_0.png)

University of Washington researcher Rajesh Rao, left, plays a computer game with his mind. Across campus, researcher Andrea Stocco, right, wears a magnetic stimulation coil over the left motor cortex region of his brain.

University of Washington

Listen 1:49

Two researchers at the University of Washington have managed to pull off something right out of a sci-fi story: one used his brain to control the body of another.

The setup involved two labs on different ends of campus. In one lab sat the receiver, Andrea Stocco, with a device on his head that beams a focused magnetic field into his brain. Across campus, in another lab sat the sender, Rajesh Rao, wearing a cap outfitted with electrodes.

"The question was whether we could transmit information from one person's brain directly to another person's brain," said Rao.

They tested this by having Rao watch a simple video game on a screen: cannon versus pirate ship. When the moment came to fire the cannon, Rao imagined his right hand reaching out and tapping the spacebar.

A half-mile away, Stocco, who could not see the video game, hit the spacebar at the exact moment, prompting someone in the lab to yell, "Yes!"

So to recap: Rao had the thought. The EEG electrodes on his head recorded it, and software translated it into a digital message. That message zipped across the Internet, where it gave a command to the magnetic coil on Stocco's head. That device zapped the part of his brain's motor cortex that controls his right hand. And voila!

How did it feel for Stocco to have someone else's brain control his own hand?

"My arm wanted to move by [itself]. It was actually moving. I saw it, like, lifting up and pressing the button," he said. "The feeling was that I was quite literally lending parts of my brain to somebody else."

The experiment is believed to be the first time one person has lent out part of his brain to another. It could open up all kinds of possibilities in the future – guiding an untrained person to pilot a plane in an emergency, for example. And yes, Rao and Stocco are well aware of how far-out this stuff sounds.

"The first thing that comes to mind is mind control," said Rao.

But they say this isn't really a step toward some sci-fi dystopia. So far the method only works for very simple, yes-no type commands, and both participants have to be willing.

TAGS: brain science (/term/brain-science)

Mind Justice
at mindjustice.org

Formerly Citizens Against Human Rights Abuse Renamed February 2004

A human rights group working for the rights and protections of mental integrity and freedom from new technologies and weapons which target the mind and nervous system.

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Endorsement by Dr. Eldon Byrd
2002 statement about "microwave hearing" by NIH (National Institute of Health) physician
Dr. Eldon Byrd 2002 letter of corroboration of NIH medical doctor statement
First ever scientific study of microwave hearing conducted by Dr. Byrd was completed, August 2002
Tragically, Dr. Byrd died of pancreatic cancer on Dec. 30, 2002
2. Secrecy News by Steven Aftergood, FAS, cites Cahra
3. Cheryl Welsh, director of Cahra listed as one of six Non-Lethal Weapons Experts in the world in UNIDIR, United Nations Institute for Disarmament Research 2002 Media Guide to Disarmament in Geneva.
For full Media Guide see
http://www.unidir.org/bdd/fiche-ouvrage.php?ref_ouvrage=92-9045-002-2-en
Cahra is listed on page 25, or see excerpt here. Media Guide cites Welsh article "Non-lethal weapons-A global issue" at Nonlethal Weapons - A Global Issue
4. UC Davis law professor Dr. Maimul Khan speaks on the philosophy of new neurotechnologies at 2003 conference in Davis, California
5. A paper entitled, *On the Need for new Criteria of Diagnosis,* by Carole Smith, now published by internet Journal of Psycho-Social Studies at www.btinternet.com/~psycho_social/

II. Research and Strategies
Chronological from 1996 to the present
1. Timeline of Significant Event in the History of Electromagnetic and Neurotechnologies
2. Fact Sheet and Targeted Individuals. Allegations match electromagnetic weapons technology. Further investigation is needed.
3. January 1998 CAHRA Research Report - Feasible facts but not known or accepted by the general public
4. Nonlethal Weapons - A Global Issue
5. International Documents in Support of Claims of the Existence of Electromagnetic Anti-Personnel Weapons
6. May 1998 CAHRA Research Report - Speculative conclusions, but inevitable future public issue of new technologies
7.2000 CAHRA Research Report - growing evidence
8. Cell phones and military radiation controversy
9. Electromagnetic Weapons: As Powerful As The Atomic Bomb
10. UC Davis Russian Psychotronics Book Translation Project
2001 Russian Book Translation Project Results
Psychotronic Golgotha by by N.I. Anisimov, 1999
Russian Protestors' photos, from the book, with comparisons to U.S. protestors
1999 Russian book on psychotronic weapons by L.I. Terehova, Moscow
Letter of Appeal to World Community from Russian human rights group
Russian federal law on electromagnetic weapons
Draft law with detailed descriptions of psychotronic weapons, Nov. 2000.
(Many thanks to the generous translation work of Ramon Ruelas.)
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13. Best video documentaries...
14. "Protections for human subjects of classified experiments still lacking", as featured in the *North Bay Progressive* newspaper. This article has been nominated for a 2004 Project Censored Story award.
Article by Cheryl Welsh: U.S. and international classified experimentation law are a disaster
Political science literature offers explanation for current and future lack of protections for human subjects of classified research. By Cheryl Welsh, Lincoln Lawschool student, March 7, 2004

NeuroSky is at the forefront of biosensor innovation with one goal in mind: to make biosensor technology available on a mass-market scale, to power a variety of wearable products that improve human health and wellness. Our heritage in electroencephalogram (EEG) science has produced hundreds of breakthrough advancements in brain monitoring. Our EEG ASIC chip solutions are used across education, entertainment, health and wellness markets globally. The world's leading research universities, including USC, Yale, Stanford, UCLA, MIT, and The University of Wollongong, have adopted our EEG biosensor solutions for their work to improve the health of the mind.

In 2014, NeuroSky will build on its ECG biosensor heritage with the release of the world's most advanced electrocardiogram (ECG) biosensor for monitoring the performance of the heart. Our ECG biosensor can monitor heart performance for not only recovering hearts, but for those individuals who are interested in overall heart health and fitness. This advanced ECG biosensor provides the foundation for hundreds of new products that will be brought to market to improve the health of the body.

NeuroSky provides optimal technology and support for our OEM, research, education and entertainment partners. We work with consumer products vice presidents, chief marketing officers, chief researchers or senior product managers in organizations that are building next-generation consumer-facing products. These partners choose NeuroSky for our advanced technology, reliable service and, especially for the quality of our highly accurate biosensor solutions.

We are building the world's most advanced biosensors for body and mind.

We are body and mind, quantified.

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Our EEG solutions incorporate sensing electrical brainwaves to power the user interface of games, educational and research applications. We amplify and process raw brain signals to deliver concise information to the device. Our algorithms, developed by NeuroSky researchers and our partner universities and research institutions, are unlocking new ways to interact with our world.

Learn more »

Complex brain imaging is making waves in court

Reyhan Harmanci, Chronicle Staff Writer

Published 4:00 am, Friday, October 17, 2008

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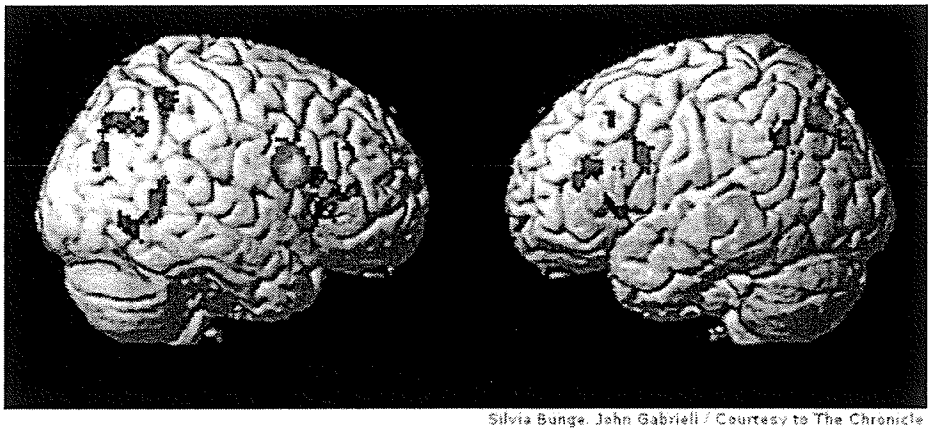

Silvia Bunge, John Gabrieli / Courtesy to The Chronicle

Taken from a 2002 paper, this fMRI shows the right ventrilateral pre-frontal cortex in adults, the region necessary for inhibiting responses. Photo: Silvia Bunge, John Gabrieli, Courtesy To The Chronicle

Science and the American legal system historically have had a complicated relationship. While good science has driven solid law, junk science like eugenics and phrenology have influenced due process with often terrible consequences.

Over the past decade, researchers have made huge advances in neuroscience, developing brain-imaging techniques that show not just the structure of the brain but its inner workings. According to experts in a new field called neurolaw, the effect of these breakthroughs on the legal system could be revolutionary.

"The law is mainly about brains or, at least, the mind," said Stanford law Professor Hank Greely, one of the directors of the year-old MacArthur Foundation-funded Law and Neuroscience Project. "If my fist hits your chin, what, if anything, I was thinking is crucial. If I was in an epileptic fit, if I was thrown from a car when I hit you, you don't convict me of

a crime. ... If I'm mad at you, we do."

The degree to which brain scans will be admissible in court remains unclear, but experts already are pointing to precedent-setting cases and warning that neuroscience could alter the law, creating new methods and new visual evidence to determine criminal intent and criminal responsibility.

Greely, 56, who directs both the law school's Center for Law and the Biosciences and the neuroethics program at the Stanford Center for Biomedical Ethics, has led the charge to make sure advances in neuroscientific research are applied cautiously to the legal realm.

"Neuroscience has some real potential to be used as important evidence in cases and give broader insights into the law," he said. "It also has the real potential to be misused. If it's applied too early, it can lead to bad results."

The law is as vulnerable to faulty cultural and scientific thinking as any other field, which is why Greely calls for vigilance in neuroscience. In the 20th century, eugenicists who sought to "improve" the American population by weeding out bad hereditary characteristics convinced courts to uphold bad policies like the sterilization of the mentally retarded. Phrenology, a quack science whereby the shape of people's skulls was thought to reveal their personality, was heralded by scientists and criminologists in the mid-19th century as way to predict criminal behavior.

The importance of fMRI

One technique in particular - functional magnetic resonance imaging (fMRI) - holds the greatest legal promise and peril. By placing a person's head in what is essentially a large magnet and asking questions, researchers can link active brain anatomy to different cognitive skills - reason, decision-making and logic and perhaps even locating the neural pathways for lying and addiction. As opposed to magnetic resonance imaging (MRI), which shows the brain's structure, fMRI charts how the brain functions and thereby relates more closely to thought and behavior.

The problem is that while scientists have become very good at collecting group brain data, individual fMRI scans are too idiosyncratic to be interpreted accurately.

"Some things we know how to detect on a scan. If your visual cortex is destroyed by a stroke, you won't be able to see. If your bronchus region is destroyed, you won't be able to talk," Greely said. "That's what makes (neuroimaging) such a tease - we've known a few of these (functions) for a long time, but for most behavior we just don't know what's going on in the brain."

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Published 4:00 am, Friday, October 17, 2008

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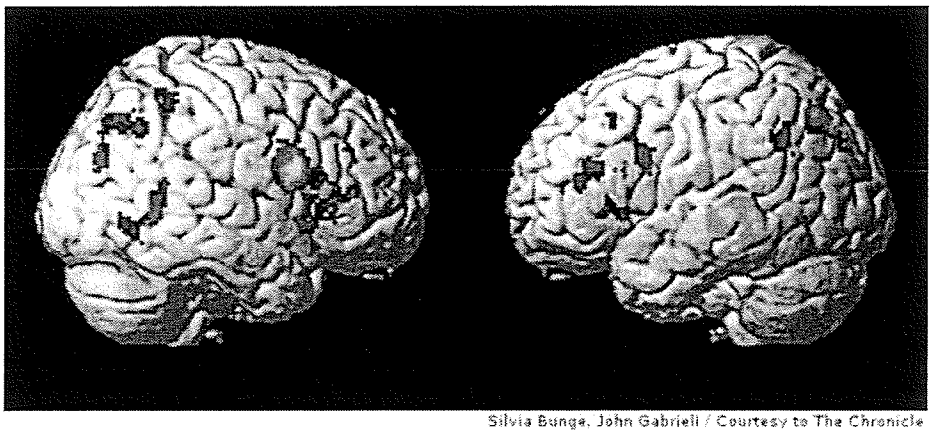

Silvia Bunge, John Gabrieli / Courtesy to The Chronicle

Taken from a 2002 paper, this fMRI shows the right ventrilateral pre-frontal cortex in adults, the region necessary for inhibiting responses. Photo: Silvia Bunge, John Gabrieli, Courtesy To The Chronicle



(Page 2 of 2)

In the United States, judges allow several kinds of brain scans, such as CT, PET and SPECT (single photon emission computed tomography) scans, primarily to show structural damage - a lesion, a tumor, some gross injury - as a mitigating factor for the defense in a criminal trial or to establish damages in a civil suit. The scans are most frequently found in sentencing hearings, where evidentiary rules are the least stringent, and, as forensic neuroscience consultant Daniel Martell told the New York Times last year, they have become de rigueur in the defense of death penalty cases.

Precedent does exist for the admittance of fMRI scans in court. In 2005, the Supreme Court admitted fMRI evidence in Roper vs. Simmons, a case involving a minor on death row, to help establish that an adolescent brain works differently than an adult one. While

Justice Anthony Kennedy didn't explicitly cite fMRI scans in his majority opinion against executing people under 18, many experts think it was an influencing factor.

The academic opposition

While the Law and Neuroscience Project hasn't issued a definitive statement on the use of fMRI in courts, some members say they don't approve its use.

"It would be fair to say that the MacArthur Law and Neuroscience consortium members feel that (this) brain imaging research is not ready to be used in the courtroom," UC Berkeley neuroscientist Silvia Bunge wrote in an e-mail. "We have discussed this issue at length in our meetings, and this is the conclusion that we all came to."

One issue for those following developments in neurolaw is that no system exists to track how often neuroimaging scans are presented in U.S. courts.

"It's unclear how often brain scans appear in trial - definitely, they appear from time to time," Greely said. He is creating a database of scan appearances in California courts.

Neuroscience has served as evidence in courts abroad. In September, a 24-year-old woman was found guilty in India's Maharashtra state court of murdering her fiance, and the presiding judge cited a "brain fingerprinting" scan called the brain electrical oscillations signature test as proof of "experiential knowledge" of the crime. BEOS purports to identify brain activation patterns for memory. U.S. experts condemned the ruling because no peer-reviewed testing of BEOS has been made available.

Critics of admitting brain scans as evidence in U.S. criminal trials cite the "CSI Effect," in which juries have come to expect the same kind of scientific crime-solving techniques depicted in forensic crime TV shows. The brain scan imagery, warns Boston University bioethicist George Annas, can be more powerful than the information they are supposed to impart.

"The immediacy and the seeming infallibility of pictures," wrote Annas in a 2007 special issue on neurolaw of the American Journal of Law & Medicine, "makes them simultaneously valuable and dangerous."

Neurolaw experts are devoting particular attention to the emerging technology of fMRI-based lie detection. As of last year, two commercial companies, No Lie MRI in San Diego and Cephos Corp. in Massachusetts, have gone public with their lie-detection services.

Steven Laken, founder of Cephos, anticipates that lie detection will be admissible in civil cases by early 2009. "I set out to achieve 95 percent accuracy before we went commercial, and we did that in 2007," Laken said. "We certainly believe that the technology will be admissible."

With 250 civilian subjects tested by Cephos, Laken said he welcomes outside researchers to independently evaluate his company's results. (Peer-reviewed papers on Cephos have been published, but none has provided a large-scale verification of the accuracy of its findings, which Laken said is the fault of the scientific community, not his company.)

"I am very nervous about unproven lie detection," said Greely, who nonetheless believes Cephos' method will be admissible to court in five years or less because individual judges are unpredictable.

Warning from bioethicists

Meanwhile, bioethicists like Emory University's Paul Root Wolpe warn that "mental privacy" and the Fifth Amendment right to withhold self-incriminating evidence are potentially threatened by neuroimaging.

In particular, researchers point to prisoners of war on terror-related activities as potential subjects for the fMRI lie-detecting methods. Greely and Wolpe agree that there is "little doubt" the U.S. government has been studying them. "We have a technology now that, under certain circumstances and in certain ways, allows us to look at activities of the brain

and deduce things that previously we never could have understood from a person without communicating with them," Wolpe said. "This raises new questions about how this technology should be used, and by whom."

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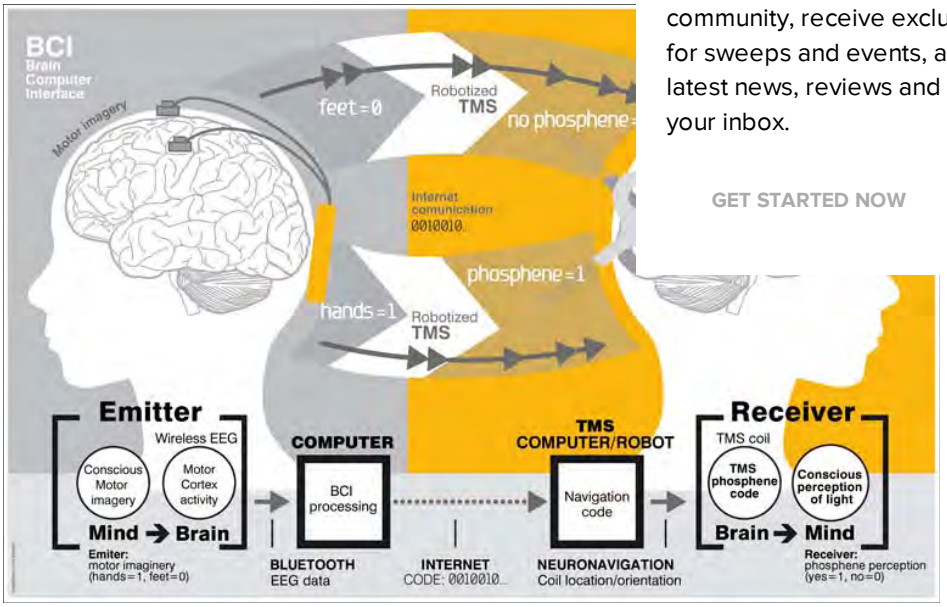
Brain-to-brain verbal communication in humans achieved for the first time

A team of researchers has successfully achieved brain-to-brain human communication using non-invasive technologies across a distance of 5,000 miles.

by Michelle Starr @riding_red / September 3, 2014 5:51 PM PDT



Grau et al/PLOS One

Humans just got a step closer to being able to think a message into someone else's brain on the other side of the world: in a first-of-its-kind study, an international team of researchers has successfully achieved brain-to-brain transmission of information between humans.

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Brain-to-brain verbal communication in humans achieved for the first time
Sci-Tech

The team, comprising researchers from Harvard Medical School teaching affiliate Beth Israel Deaconess Medical Center, Starlab Barcelona in Spain, and Axilum Robotics in Strasbourg, France, used a number of technologies that enabled them to send messages from India to France -- a distance of 5,000 miles (8046.72km) -- without performing invasive surgery on the test subjects.

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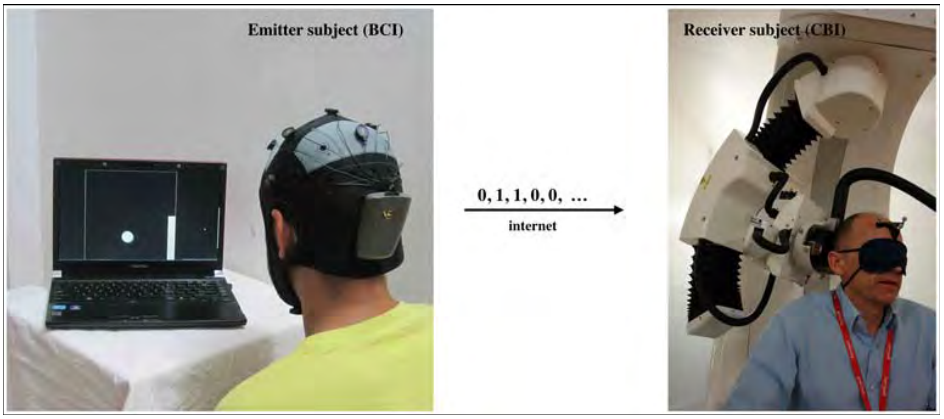
"We wanted to find out if one could communicate directly between two people by reading out the brain activity from one person and injecting brain activity into the second person, and do so across great physical distances by leveraging existing communication pathways," said co-author Alvaro Pascual-Leone, MD, PhD, director of the Berenson-Allen Center for Noninvasive Brain Stimulation at Beth Israel Deaconess Medical Center and Professor of Neurology at Harvard Medical School.

"One such pathway is, of course, the internet, so our question became, 'Could we develop an experiment that would bypass the talking or typing part of internet and establish direct brain-to-brain communication between subjects located far away from each other in India and France ?'"

Using a combination of internet-connected electroencephalogram and robot-assisted, image-guided **transcranial magnetic stimulation** (which, as the name suggests, uses electromagnetic induction to stimulate the brain from the outside), the team was able to communicate words from one human to another.

The team used a similar set-up to that commonly used in brain-computer interface studies. A human subject had electrodes attached to their scalp, which recorded electrical currents in the brain as the subject had a specific thought. Usually, this is interpreted by a computer and translated to a control output, such as a robotic arm, or a drone.

In this case, though, the output target was another human.



The emitter on the left being shown the binary code, and the receiver on the right.

Grau et al/PLOS One

The study had four participants, aged between 28 and 50. One participant was assigned to the brain-computer interface to transmit the thought, while the other three were assigned to the computer-brain interface to receive the thought.

At the BCI end, the words "Ciao" and "Hola" were translated into binary. This was then shown to the emitter subject, who was instructed to envision actions for each piece of information: moving their hands for a 1 or their feet for a 0. An EEG then captured the electrical information in the sender's brain as they thought of these actions, which resulted in a sort of neural code for the binary symbols -- which in turn was code for the words.

This information was then sent to the three recipient subjects via TMS headsets, stimulating the visual cortex so that the recipient, with ears and eyes covered, saw the binary string as a series of bright lights in their peripheral vision: if the light appeared in one location, it was a 1, and the second location denoted a 0. This information was received successfully and decoded as the transmitted words.

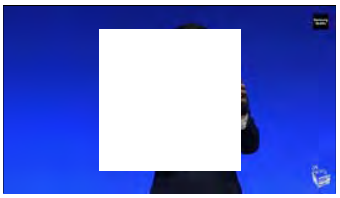
This experiment, the researchers said, represents an important first step in exploring the feasibility of complementing or bypassing traditional means of communication, despite its current limitations -- the bit rates were, for example, quite low at two bits per minute. Potential applications, however, include communicating with stroke patients, for example.

"We anticipate that computers in the not-so-distant future will interact directly with the human brain in a fluent manner, supporting both computer- and brain-to-brain communication routinely," the team concluded. "The widespread use of human brain-to-brain technologically mediated communication will create novel possibilities for human interrelation with broad social implications that will require new ethical and legislative responses."

You can read **the full study online in the journal PLOS One**.

Tags: Crave, Sci-Tech

FEATURED VIDEO



PHONES

Samsung reveals latest phablets, Galaxy Note 4, and Note Edge

Samsung updates its Note line with two new smartphone designs at the IFA trade show in Berlin, Germany. The Galaxy Note 4 boasts a quad HD 5.7-inch display and a 16-megapixel camera, while the Galaxy Edge sports an all new curved display. / **WATCH VIDEO**

ABOUT THE AUTHOR

Michelle Starr /

Michelle Starr is the tiger force at the core of all things. She also writes about cool stuff and apps as CNET Australia's Crave editor. But mostly the tiger force thing. See full bio

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January 21, 2014

General Martin E. Dempsey
Chairman of the Joint Chiefs of Staff
9999 Joint Staff Pentagon
Washington, DC 20318-9999

Regarding: Top Secret Torture Program

Dear General Dempsey:

As some background, I previously worked for Parsons (a major federal contractor) and was involved in top-level technology at the company. My first day on the job was September 10, 2001. We all know what happened the next day. After some disagreements over some issues, I left Parsons but have continued to be involved in a SAP based on psychotronics (SAP designation may be AQAC or BAK). As you may know, psychotronics is basically telepathic communication via the brain, helped by technology. We have recently seen some applications of this technology in the commercial sector, such as robotic manipulation via the brain. Likewise, Mr. Obama's recent announcement to "map" the brain is another example, which has already been accomplished. Each word in a language can be mapped to a specific and unique region of the brain. Once each word has been mapped to the individual brain, algorithms and computers monitoring the brain can interpret the brain's regions that "light up" into the actual thoughts and language of the subject. The four following websites illustrate this technology and some of the potential hazards:

http://science.dodlive.mil/2010/09/01/remote-control-of-brain-activity-using-ultrasound
http://kplu.org/post/uw-researchers-use-brain-one-control-body-another
http://neurotrek.com/applications/
http://www.mindjustice.org/#3

I know this technology is being used to torture many humans and I want to stop it from occurring, as noted in Congressman Dennis Kucinich's HR 2977 and Federal Assembly, Parliament of the Russian Federation, Governmental Duma, Committee on Safety, Resolution from the 30th of November of the year 2000, No. 28/3. In addition, people involved in this SAP are abusing their power, are fraudulent and display corrupt characteristics. This technology and situation has major implications for the future of humankind. It is my hope to work within the system and laws to stop this gross torture of humans and bring this SAP to a conclusion and move forward to the future. It would be my pleasure to further discuss this with you. I look forward to the future and the possibility to work with you on this problem and opportunity. I request consultation with Navy personnel who have the classifications (Top Secret and Special Access) necessary to discuss this without jeopardizing myself, the Federal Government and/or the population at large. In addition, I am requesting military protection from retaliation against me for my services to the United States of America. Traitors are currently plotting against the United States of America and if General Dempsey and the Joint Chiefs of Staff do not act upon this information, the General and JCS could be deemed by law as aiding known traitors. That is not a threat. It is advice from someone who knows the law.

Sincerely,

Lucas Whitman Pomeroy

Enclosure: Email correspondence with FBI and others.

LUCAS WHITMAN POMEROY
528 HUDSON COURT
DAVIS, CA 95616
530.219.7595
LWPOMEROY@YAHOO.COM

December 17, 2013

Mr. James Clapper
Office of the Director of National Intelligence
Washington, DC 20511

Regarding: UPDATE: Top Secret Special Access Program AQAC & BAK

Dear Mr. Clapper:

As some background, I previously worked for Parsons (a major federal contractor) and was involved in top-level technology at the company. My first day on the job was September 10, 2001. We all know what happened the next day. After some disagreements over some issues, I left Parsons but have continued to be involved in a SAP based on psychotronics (SAP designation may be AQAC or BAK). As you may know, psychotronics is basically telepathic communication via the brain, helped by technology. We have recently seen some applications of this technology in the commercial sector, such as robotic manipulation via the brain. Likewise, Mr. Obama's recent announcement to "map" the brain is another example, which has already been accomplished. Each word in a language can be mapped to a specific and unique region of the brain. Once each word has been mapped to the individual brain, algorithms and computers monitoring the brain can interpret the brain's regions that "light up" into the actual thoughts and language of the subject. The three following websites illustrate this technology:

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http://neurotrek.com/applications/

I know this technology is being used to torture many humans and I want to stop it from occurring, as noted in Congressman Dennis Kucinich's HR 2977 and Federal Assembly, Parliament of the Russian Federation, Governmental Duma, Committee on Safety, Resolution from the 30th of November of the year 2000, No. 28/3. In addition, people involved in this SAP are abusing their power, are fraudulent and display corrupt characteristics. This technology and situation has major implications for the future of humankind. It is my hope to work within the system and laws to stop this gross torture of humans and bring this SAP to a conclusion and move forward to the future. It would be my pleasure to further discuss this with you. I look forward to the future and the possibility to work with you on this problem and opportunity. I request consultation with ODNI personnel who have the classifications (Top Secret and Special Access) necessary to discuss this without jeopardizing myself, the Federal Government and/or the population at large. In addition, I am requesting FBI protection from retaliation against me for my services to the United States of America.

A copy of the Services Rendered Contract I have with the Federal Government is provided for your convenience. This contract is partially for my security as the Federal Government has put me in extreme jeopardy. All services have been rendered and the contract has not been signed or executed. This contract must be addressed prior to any other discussions or future employment. Thank you for your time.

Sincerely,

Lucas Whitman Pomeroy

Enclosure: Contract for Services Rendered

LUCAS WHITMAN POMEROY
528 HUDSON COURT
DAVIS, CA 95616
LWPOMEROY@YAHOO.COM
530.219.7595

March 19, 2013

Mr. John Brennan
Central Intelligence Agency
Washington, DC 20505

Regarding: Special Access Program AQAC & BAK

Mr. Brennan:

From my research I understand that you are legally responsible and accountable for all SAPs involving intelligence matters, depending on assignments. I am involved in a SAP and I think you are very aware of it. As some background, I previously worked for Parsons (a major federal contractor) and was involved in top-level technology at the company. My first day on the job was September 10, 2001. We all know what happened the next day. After some disagreements over some issues, I left the company but have continued to be involved in a SAP based on psychotronics (SAP designation may be AQAC or BAK). As you may know, psychotronics is basically telepathic communication via the brain, helped by technology. We have recently seen some applications of this technology in the commercial sector, such as robotic manipulation via the brain. Likewise, Mr. Obama's recent announcement to "map" the brain is another example, which has already been accomplished. Each word in a language can be mapped to a specific and unique region of the brain. Once each word has been mapped to the individual brain, algorithms and computers monitoring the brain can interpret the brain's regions that "light up" into the actual thoughts and language of the subject.

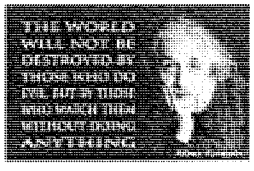
I know this technology is being used to torture humans and I want to stop it from occurring, as noted in Mr. Kucinich's HR 2977. As Director of the Central Intelligence Agency, you are in a position to help me. This technology and situation has major implications for the future of humankind. It is my hope to work within the system and laws to stop this gross torture of humans and bring this SAP to a conclusion and move forward to the future. It would be my pleasure to further discuss this with you and/or whoever else has the balls to deal with this situation. I look forward to the future and the possibility to work with you on this problem and opportunity.

In case you have not received a copy of the Services Rendered Contract, I have provided it for your convenience. I will be sending out versions of this letter to government and military people until I have received a signed and executed contract with all the essentials.

Have a nice day,

Lucas Whitman Pomeroy AQAC, BAK, MBA

Cc: Susan Gibson (Letter of March 18th to Mr. Clapper), Richard Fravel (Letter of March 18th to Mr. Clapper), James Clapper (Letter of March 18th), Barak Obama
Enclosure: Contract for Services Rendered



LUCAS WHITMAN POMEROY
528 HUDSON COURT
DAVIS, CA 95616
LWPOMEROY@YAHOO.COM
530.219.7595

March 21, 2013

Dianne Feinstein
One Post Street, Suite 2450
San Francisco, CA 94104

Regarding: Special Access Program AQAC & BAK

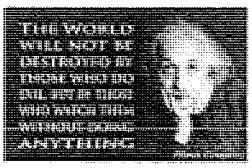
Dianne Feinstein:

I have sent you various communications regarding a SAP I am involved in. I have not received any reciprocal communications and will be ending this conflict, with or without you. From my research I understand that you are legally responsible and accountable for all SAPs involving intelligence matters, depending on assignments. As some background, I previously worked for Parsons (a major federal contractor) and was involved in top-level technology at the company. My first day on the job was September 10, 2001. We all know what happened the next day. After some disagreements over some issues, I left Parsons but have continued to be involved in a SAP based on psychotronics (SAP designation may be AQAC or BAK). As you may know, psychotronics is basically telepathic communication via the brain, helped by technology. We have recently seen some applications of this technology in the commercial sector, such as robotic manipulation via the brain. Likewise, Mr. Obama's recent announcement to "map" the brain is another example, which has already been accomplished. Each word in a language can be mapped to a specific and unique region of the brain. Once each word has been mapped to the individual brain, algorithms and computers monitoring the brain can interpret the brain's regions that "light up" into the actual thoughts and language of the subject.

I know this technology is being used to torture humans and I want to stop it from occurring, as noted in Mr. Kucinich's HR 2977 and Federal Assembly, Parliament of the Russian Federation, Governmental Duma, Committee on Safety, Resolution from the 30th of November of the year 2000, No. 28/3. As the rank of Senator, you are in a position to help me. This technology and situation has major implications for the future of humankind. It is my hope to work within the system and laws to stop this gross torture of humans and bring this SAP to a conclusion and move forward to the future. It would be my pleasure to further discuss this with you and/or whoever else has the balls to deal with this situation. I look forward to the future and the possibility to work with you on this problem and opportunity. Morals and principles are not relative. If you disagree with my morals and principles, we have a problem.

In case you have not received a copy of the Services Rendered Contract, I have provided it for your convenience. I will be sending out versions of this letter to government, industry and military people until I have received a signed and executed contract with all the essentials.

Have a nice day,



Lucas Whitman Pomeroy AQAC, BAK, MBA

Cc: Susan Gibson (Letter of March 18th to Mr. Clapper), Richard Fravel (Letter of March 18th to Mr. Clapper), James Clapper (Letter of March 18th), Barak Obama (Letter of March 19th to Mr. Brennan), John Brennan (Letter of March 19th), Bryan B. Battaglia (Letter of March 20th to Mr. Dempsey), Martin Dempsey (Letter of March 20th), Charles Harrington (Letter of March 20th), Mike Rogers
Enclosure: Contract for Services Rendered

LUCAS WHITMAN POMEROY
528 HUDSON COURT
DAVIS, CA 95616
LWPOMEROY@YAHOO.COM
530.219.7595

November 4, 2013

Attorney General Holder
U.S. Department of Justice
950 Pennsylvania Avenue, NW
Washington, DC 20530-0001

Regarding: Special Access Program AQAC & BAK

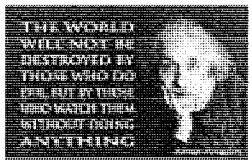
Dear Attorney General Holder:

As some background, I previously worked for Parsons (a major federal contractor) and was involved in top-level technology at the company. My first day on the job was September 10, 2001. We all know what happened the next day. After some disagreements over some issues, I left Parsons but have continued to be involved in a SAP based on psychotronics (SAP designation may be AQAC or BAK). As you may know, psychotronics is basically telepathic communication via the brain, helped by technology. We have recently seen some applications of this technology in the commercial sector, such as robotic manipulation via the brain. Likewise, Mr. Obama's recent announcement to "map" the brain is another example, which has already been accomplished. Each word in a language can be mapped to a specific and unique region of the brain. Once each word has been mapped to the individual brain, algorithms and computers monitoring the brain can interpret the brain's regions that "light up" into the actual thoughts and language of the subject.

I know this technology is being used to torture humans and I want to stop it from occurring, as noted in Congressman Dennis Kucinich's HR 2977 and Federal Assembly, Parliament of the Russian Federation, Governmental Duma, Committee on Safety, Resolution from the 30th of November of the year 2000, No. 28/3. As Attorney General, you are in a position to help me. This technology and situation has major implications for the future of humankind. It is my hope to work within the system and laws to stop this gross torture of humans and bring this SAP to a conclusion and move forward to the future. It would be my pleasure to further discuss this with you. I look forward to the future and the possibility to work with you on this problem and opportunity.

In case you have not received a copy of the Services Rendered Contract, I have provided it for your convenience. I will be sending out versions of this letter to government, industry and military people until I have received a signed and executed contract with all the essentials. This contract is for my security as the Federal Government has put me in extreme jeopardy.

Sincerely,



Lucas Whitman Pomeroy AQAC, BAK, MBA

Cc: Chuck Hagel, Reggie Walton, FISA(November 3, 2013) Susan Gibson (Letter of March 18th to Mr. Clapper), Richard Fravel (Letter of March 18th to Mr. Clapper), James Clapper (Letter of March 18th), Barak Obama (Letter of March 19th to Mr. Brennan), John Brennan (Letter of March 19th), Bryan B. Battaglia (Letter of March 20th to Mr. Dempsey), Martin Dempsey (Letter of March 20th), Charles Harrington (Letter of March 20th), Mike Rogers and others
Enclosure: Contract for Services Rendered

LUCAS WHITMAN POMEROY
528 HUDSON COURT
DAVIS, CA 95616
530.219.7595
LWPOMEROY@YAHOO.COM

December 17, 2013

Special Agent in Charge Monica M. Miller
Federal Bureau of Investigation Sacramento
4500 Orange Grove
Sacramento, CA 95841

Regarding: DOJ OIG Investigation of Top Secret Special Access Program AQAC & BAK

Dear Special Agent Miller:

As some background, I previously worked for Parsons (a major federal contractor) and was involved in top-level technology at the company. My first day on the job was September 10, 2001. We all know what happened the next day. After some disagreements over some issues, I left Parsons but have continued to be involved in a SAP based on psychotronics (SAP designation may be AQAC or BAK). As you may know, psychotronics is basically telepathic communication via the brain, helped by technology. We have recently seen some applications of this technology in the commercial sector, such as robotic manipulation via the brain. Likewise, Mr. Obama's recent announcement to "map" the brain is another example, which has already been accomplished. Each word in a language can be mapped to a specific and unique region of the brain. Once each word has been mapped to the individual brain, algorithms and computers monitoring the brain can interpret the brain's regions that "light up" into the actual thoughts and language of the subject. The three following websites illustrate this technology:

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A copy of the Services Rendered Contract I have with the Federal Government is provided for your convenience. This contract is partially for my security as the Federal Government has put me in extreme jeopardy. All services have been rendered and the contract has not been signed or executed. This contract must be addressed prior to any other discussions. Thank you for your time.

Sincerely,

Lucas Whitman Pomeroy

Cc: FBI Director James Comey and Special Agent in Charge David A. Johnson
Enclosure: Contract for Services Rendered

EXHIBIT 4

Documents

Contract

Example Cease and Desist Agreement

EXHIBIT 4

CONTRACT FOR SUPPLY OF SECURITY SERVICES TO UNITED STATES FEDERAL GOVERNMENT

PARTIES

Supplier

Name: Lucas W. Pomeroy
Legal Form: Individual Party (corporation to be formed after signing of contract, see Item 14 of this contract)
Country of Incorporation: United States of America, when applicable
Address: 528 Hudson Court, Davis, California, 95616, USA
Representation: Hayes H. Gable, Criminal Lawyer, Sacramento, California

Client

Name: United States Federal Government, signatories Barack Obama, Reggie Walton, John Roberts, John Brennen, Michael Flynn, Keith Alexander, Martin Dempsey, Dianne Feinstein, Eric Holder and Michael Rogers. All signatures are required (among others as identified in Item 13 of this contract).
Legal form: Government Officials and or Government Agents
Address: The White House
Represented by: Eric Holder

Supply of Services
Background

A. The Supplier carries on business in the personal and government security industry.

B. The Supplier undertakes as part of its business the provision of services in relation to security of the United States and the security of the Client(s).

C. The Client wishes to engage the Supplier to provide such services in relation to the Client's business, and the Supplier is willing to provide such services accordingly, on the terms of this contract.

D. This contract is for the purposes of engaging the Supplier for security services for the United States in case of catastrophe or other problem.

Operative Provisions

1. Supply of the Service – Qualifications of the Supplier

1.1 The Supplier shall provide the following service(s) to the Client, subject to the terms agreed in this contract and the more detailed specifications contained in Schedule 1:

– Personal and Government Security Services

1.2 The Supplier represents that he and his benefactors have all necessary capacity and qualifications to supply the aforementioned services.

1.3 The service(s) to be provided to the Client by the Supplier under this contract shall be rendered at/in:

– United States, California, Davis or other.

2. Payment of Fees

2.1 The Client shall pay the fees and expenses agreed with the Supplier, as specified in Schedule 2, and any additional sums which are agreed between the Supplier and the Client for the provision of the service.

2.2 The Client will write a check to the Supplier at signing and execution of this contract for the full amount of the contract and send the signed contract(s) and payment to the addressed specified for the Supplier.

2.3 The Supplier's standard charges and any additional sums payable shall be paid by the Client (together with any applicable value added tax, and without any set-off or other deduction) within 30 days of the date of receipt of this contract.

2.4 If this contract is not signed and executed within 60 days of receipt, the contract will be deemed null and void and the Supplier will no longer entertain the offer of providing services to the Client, under this contract.

3. Warranties and Liability

3.1 Where the Supplier supplies in connection with the provision of the service or goods supplied by a third party or his benefactors, the Supplier does not give any warranty, guarantee or other term as to their quality, fitness for purpose or otherwise.

3.2 The Supplier has no liability for any loss, damage, costs, expenses or other claims for compensation arising from any material or instructions supplied by the Supplier which are incomplete, incorrect, inaccurate, illegible, out of sequence or in the wrong form, or arising from their late arrival or non-arrival, or any other fault of the Supplier.

4. Term, Termination and Consequences of Termination

4.1 This contract shall take effect on the date of it's signature by all parties or, if signatures do not occur simultaneously, when the latest signature is given. This contract shall continue for a period of five years, to be renewed after that time in accordance with a new contract.

4.2 The Supplier may forthwith terminate this contract by giving written or notice to the Client, if the latter fails to pay any sum payable by it under this contract within 30 days of signing of this contract.

4.3 The Supplier may (without limiting any other remedy) at any time terminate the contract by giving written notice to the other if the other commits any breach of this contract and (if capable of remedy) fails to remedy the breach within 10 days after being required by written notice to do so, or if the other goes into liquidation, becomes bankrupt, makes a voluntary arrangement with its creditors or has a receiver or administrator appointed. For the purposes of the present sub-clause, a breach of any provision of this contract shall be considered capable of remedy if the party in breach can comply with the provision in question in all respects other than as to the time of performance. If the Supplier feels threatened by providing such services to the Client at any time during the duration of the contract, the services will cease and the full payment of the contract will be retained.

4.4 The termination of this contract for any reason shall not affect:

4.4.1 The Supplier's accrued rights, remedies or liabilities including all Fees and Expenses; or

4.4.2 The coming into force or the continuance in force of any provision of this contract which is expressly or by implication intended to come into or continue in force on or after termination.

5. Confidentiality

5.1 Both parties understand and acknowledge that, by virtue of the present contract, they may both receive or become aware of information belonging or relating to the other party, its business, business plans, affairs or activities, which information is confidential and proprietary to the other party and/or its suppliers and/or customers and in respect of which they are bound by a strict duty of confidence.

5.2 In consideration of such Confidential Information being disclosed or otherwise made available to either party for the purposes of the performance of the present contract, both parties hereby undertake that they will not at any time, either before or after the termination of the present contract, and either directly or indirectly, disclose, divulge or make unauthorized use of any Confidential Information, except to the extent to which such Confidential Information:

5.2.1 Is publicly known at the time of its disclosure or being lawfully made available to them;

5.2.2 After such disclosure or being made available to them, becomes publicly known otherwise than through a breach of this undertaking;

5.2.3 Is required by law, regulation or order of a competent authority (including any regulatory or governmental body or securities exchange) to be disclosed by one of the Parties, provided that, where practicable, the other party is given reasonable advance notice of the intended disclosure;

5.2.4 Protects the Supplier from any negative covert and non-covert actions taken by ANY government agency from ANY nation, or individual.

5.3 Upon the earlier of a request from the other party or the termination of this contract, each party shall return the other all documents or records in any medium or format containing any Confidential Information which are in its possession or control and will not retain any copies of them.

6. Force majeure – Excuse for Non-Performance

6.1 "Force majeure" means war, emergency, accident, fire, earthquake, flood, storm, industrial strike or other impediment which the affected party proves was beyond its control and that it could not reasonably be expected to have taken the impediment into account at the time of the conclusion of this contract or to have avoided or overcome it or its consequences.

6.2 If the Client is affected by force majeure, full payment will be retained by the Supplier.

6.3 If any force majeure occurs in relation to the Supplier which affects or is likely to affect the performance of any of the Supplier's obligations under this contract, the Supplier shall notify the Client within a reasonable time as to the nature and extent of the circumstances in question and their effect on the Supplier's ability to perform. The Supplier is not responsible for information that is acquired by the Client in relation to any force majeure that was not provided to the Supplier, or any other unforeseen force majeure.

7. Change of Circumstances (Hardship)

7.1 Where the performance of this contract becomes more onerous for the Supplier, the Client is nevertheless bound to perform its obligations subject to the following provisions on change of circumstances (hardship).

7.2 If, however, after the time of conclusion of this contract, events occur which have not been contemplated by the Supplier and which fundamentally alter the equilibrium of the present contract, thereby placing an excessive burden on the Supplier in the performance of the Suppliers contractual obligations (hardship), the Supplier shall be entitled to request revision of this contract provided that:

7.2.1 The events could not reasonably have been taken into account by the Supplier at the time of conclusion and execution of this contract;

7.2.2 The events are beyond the control of the Supplier; and

7.2.3 The risk of the events is not one which, according to this contract, the Supplier should be required to bear.

7.3 Each party shall in good faith consider any proposed revision seriously put forward by the other party in the interests of the relationship between the Parties.

7.4 If the Parties fail to reach agreement on the requested revision within 30 days, the contract will be deemed fulfilled and full payment will be retained by the Supplier.

8. No Partnership or Agency

8.1 Nothing in this contract shall (i) be deemed to constitute a partnership in law between the Parties, (ii) constitute either party the agent of the other for any purpose or (iii) entitle either party to commit or bind the other (or any member of its respective group) in any manner.

9. Assignment and Subcontracting

9.1 This contract is personal to the Parties and neither party shall without the prior written approval of the other:

9.1.1 Assign, mortgage, charge or otherwise transfer or deal in, or create any trust over, any of its rights; or

9.1.2 Subcontract or otherwise delegate the whole or any part of its rights or obligations under this contract to another person, aside from Supplier's benefactors.

10. Notices

10.1 Any notice under this contract shall be in writing (which may include e-mail) and may be served by leaving it or sending it to the address of the other party as specified in Article 10.2 below in a manner that ensures receipt of the notice can be proved.

10.2 For the purposes of Article 10.1, notification details are the following, unless other details have been duly notified in accordance with this Article:

– Contract Acceptance and Signing
– Any payments made by the Client to Supplier
– All documents related to the services of the Supplier

11. Entire Agreement

This contract sets out the entire agreement between the Parties. Neither party has entered into this contract in reliance upon any representation, warranty or undertaking of the other party that is not expressly set out or referred to in this contract. This Article shall not exclude any liability for fraudulent misrepresentation. This contract supersedes any previous agreement or understanding relating its subject matter.

This contract may not be varied except by an agreement of the Parties in writing (which may include e-mail).

12. Effect of Invalid or Unenforceable Provisions

If any provision of this contract is held by any court or other competent authority to be invalid or unenforceable in whole or in part, this contract shall continue to be valid as to its other provisions and the remainder of the affected provision, unless it can be concluded from the circumstances that, in the absence of the provision found to be null and void, the Parties would not have concluded this contract. The Parties shall use all reasonable efforts to replace all provisions found to be null and void by provisions that are valid under the applicable law and come closest to their original intention.

13. Authorizations

13.1 This contract is conditional upon the following authorizations first being obtained, if necessary.

– Authorization by all the applicable US Federal Government agencies and branches.
– Signatures from the top official(s) in each agency and branch, including the President of the United States.

13.2 The relevant party shall use all reasonable efforts on its part to obtain such authorizations and shall notify the other party promptly of any difficulty encountered.

14. Development of Remedy Corporation and Distribution of Funds

14.1 Within a year of execution of this contract a remedy corporation, Buckle & Bernard Agency Developers, LLC will be set up by the Supplier for the purpose of providing financial restitution and other services. The details are to be determined and will be classified Top Secret.

15. Dispute Resolution

15.1 Any dispute, controversy or claim arising out of or relating to this contract, in particular its conclusion, interpretation, performance, breach, termination or invalidity, shall be finally settled by the courts of United States of America which will have exclusive jurisdiction. Due to a classified nature, the Supplier holds the right to dispute this contract, or any controversy or claim arising out of or relating to this contract, in

FISC, or similar classified US Court, now or in the future. All related classified information is admissible.

16. Applicable law

All United States Federal law shall apply to this contract. Any local laws within the State of California, County of Yolo are also applicable.

Schedule 1: Specifications of the service(s) to be performed:

Personal and Government Security Services

Schedule 2: Fees and Expenses

A one-time full payment of $1 billion U.S. dollars will be paid to the Supplier with a written check and sent to the Supplier's address, at signing of this contract. All financial restitution payments or other, applicable under 14. Development of Remedy Corporation and Distribution of Funds, will be above and beyond this initial payment.

17. Signatures

In witness of their agreement to the terms above, the parties hereby affix their signatures:

_____	_____
(Printed Name of Supplier or agent)	(Printed Name of Client(s) or agent(s))
_____	_____
(Signature of Supplier or agent) (Date)	(Signature of Client(s) or agent(s)) (Date)

CEASE AND DESIST COMPLIANCE AGREEMENT

I, (insert perpetrator's name here)_____understand that Lucas W. Pomeroy has not waived his rights and may pursue legal remedies against me if I fail to abide by this agreement. I understand that this agreement is not specifically limited to the activities named herein. I will not engage in any activity now or in the future done for the purpose of stalking or harassing Lucas W. Pomeroy. I furthermore agree not to engage in any activity, regardless of its official title, that is done in violation of Lucas W. Pomeroy's legal rights. If I fail to cease performing these activities, Lucas W. Pomeroy may pursue legal action against me in accordance his legal rights. This agreement acts as a contract between _____and Lucas W. Pomeroy. Forbearing enforcement of legally enforceable remedies is sufficient consideration to support this agreement. This agreement represents the entire agreement between the parties. Any statements made orally, written, or otherwise which are not contained herein shall have no impact on either parties' rights or obligations elaborated in this agreement. I also agree to sign and execute the contract between Lucas W. Pomeroy and the U.S. Federal Government, as included in Lucas W. Pomeroy's petition to Judicial Complaint No. DC-14-90001. Also, I will not continue to participate in any Special Access Programs (SAP) associated with Lucas W. Pomeroy. I will bring the SAP(s) to a conclusion or I will suffer all available options available for punishment.

Date _____

_____
(Perpetrator's printed name)

_____
(Perpetrator's signature)