14º Simpósio da Fundação Bial

Aquém e Além do Cérebro

Behind and Beyond the Brain

Casa do Médico - Porto • 3 a 6 de abril de 2024

Bial 30 years
FOUNDATION

Creativity

O livro "Aquém e Além do Cérebro" contém as atas do 14.º Simpósio da Fundação BIAL, realizado na Casa do Médico, de 3 a 6 de abril de 2024, tendo como membros da Comissão Organizadora os Senhores Professores Axel Cleeremans, Etzel Cardeña, Miguel Castelo-Branco, Rui Costa, Rainer Goebel, Stefan Schmidt e Caroline Watt.
Os textos estão disponíveis em www.bialfoundation.com.

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SESSÃO DE ABERTURA
OPENING SESSION

DISCURSO DO PRESIDENTE DA FUNDAÇÃO BIAL

Luís Portela

Bem-vindos ao XIV Simpósio Aquém e Além do Cérebro! Temos muito gosto em vos receber na altura em que a Fundação BIAL faz 30 anos e em que a empresa farmacêutica BIAL comemora 100 anos. Parabéns a BIAL e a todos os seus colaboradores pela longa e profícua vida da empresa! A expressão da nossa gratidão pela criação e pelo continuado suporte desta Fundação.

A Fundação BIAL é uma instituição sem fins lucrativos, considerada de utilidade pública, criada em maio de 1994 pela empresa BIAL e pelo Conselho de Reitores das Universidades Portuguesas e é, desde então, gerida por representantes destas duas instituições. Tem o objetivo de "incentivar o estudo científico do ser humano, tanto do ponto de vista físico, como do ponto de vista espiritual". E fá-lo numa postura 100% mecenática, sem pedir nem aceitar nada dos seus premiados ou dos seus bolseiros.

A primeira atividade da Fundação foi a gestão do Prémio BIAL de Medicina Clínica, que tinha sido criado em 1984 - há 40 anos - pela empresa BIAL, tendo em vista incentivar o desenvolvimento da investigação clínica em Portugal e nos restantes países de língua portuguesa. É atribuído nos anos pares.

Em 2019 criámos o *BIAL Award in Biomedicine*, que distingue o trabalho de investigação publicado a nível mundial nos últimos dez anos, que mais tenha contribuído para melhorar as condições de saúde da humanidade. É atribuído nos anos ímpares. E em 2021 criámos o Prémio Maria de Sousa, em parceria com a Ordem dos Médicos, que apoia anualmente jovens investigadores até aos 35 anos. Qualquer dos prémios é escolhido por júris independentes.

Em paralelo, a Fundação criou em 1994 um sistema de bolsas de apoio à investigação científica nas áreas da Psicofisiologia e da Parapsicologia, que se tem vindo a repetir nos anos pares. A seleção dos projetos a apoiar é feita pelo nosso Conselho Científico, constituído por 60 cientistas de todo o mundo e presidido pelo neurocientista António Damásio.

Nestes 30 anos, a Fundação BIAL apoiou com bolsas 865 projetos de investigação, cerca de metade na área da psicofisiologia e a outra metade envolvendo a parapsicologia. Estes projetos foram desenvolvidos em universidades de 30 países por 1.702 investigadores e deles resultaram, até agora, 2.457 artigos científicos, de que foram contabilizadas, até agora, 45.764 citações.

Tenho agora o gosto de lhes anunciar a abertura de um novo concurso, com características semelhantes aos anteriores. O regulamento e a documentação para concurso estarão disponíveis a partir de amanhã no nosso site. Permitam-me realçar que continuaremos a não apoiar projetos de patologia ou de terapêutica, por desejarmos separar claramente a atividade mecenática da Fundação da investigação realizada pelos Laboratórios BIAL, essa sim focada na terapêutica farmacológica.

Desde 1996 organizamos, de dois em dois anos, os nossos simpósios Aquém e Além do Cérebro, com o principal objetivo de darmos a conhecer à comunidade científica e ao público em geral os resultados da investigação dos nossos bolseiros. Estão expostos, na galeria ao lado, 48 posters com os resultados mais recentes e na tarde de amanhã teremos a apresentação oral desses resultados.

Mas também convidamos sempre um conjunto de investigadores de primeiro plano a nível internacional para participarem na discussão de um tema, sendo o deste ano a criatividade. E aqui temos um excelente conjunto de palestrantes que vão, certamente, deliciar-nos com as suas apresentações e com um enriquecedor diálogo interdisciplinar. Muito obrigado a todos aqueles - bolseiros ou não - que aceitaram participar neste nosso XIV simpósio.

Um agradecimento maior à Comissão Organizadora desta edição, pelo excelente programa que nos proporcionam. O nosso muito obrigado pela elevada competência, pela grande dedicação e pelo enorme entusiasmo com que organizaram mais este simpósio, aos Professores Axel Cleeremans, Etzel Cardeña, Miguel Castelo-Branco, Rui Costa, Rainer Goebel, Stefan Schmidt e Caroline Watt.

Este ano, queremos fazer um agradecimento muito especial à Prof. Caroline Watt, que não fará parte da equipa que irá organizar o XV simpósio, a ter lugar em março ou abril de 2026. Há quase 20 anos, em setembro de 2004, convidámos a Prof.ª Caroline Watt para se juntar a nós, logo após a

passagem prematura do seu Diretor na Koestler Parapsychology Unit da Universidade de Edimburgo, o nosso querido amigo Prof. Robert Morris. Caroline Watt substituiu-o na Universidade de Edimburgo e também na Fundação BIAL, quer no Conselho Científico, quer na Comissão Organizadora dos nossos simpósios.

Tivemos e temos uma forte relação com a Koestler Parapsychology Unit, a quem apoiámos 20 projetos de investigação, cinco dos quais com a participação da Prof. Caroline.

Ela foi um membro dedicado e diligente das nossas Comissões Organizadoras, sempre disponível, com uma postura sempre construtiva e sempre mantendo um elevado nível de exigência. Moderou muitas sessões dos nossos simpósios e foi duas vezes palestrante, em 2002 e em 2012. É o mais antigo membro da nossa Comissão e sai para renovarmos o grupo, mas mantém-se no Conselho Científico da Fundação BIAL.

Muito e muito obrigado, Caroline, por toda a sua colaboração. Como sabe, é grande a estima que todos lhe temos. Por nós, a sua ligação à Fundação manter-se-á para sempre. Continuará sempre a ser um dos nossos. Um grande e muito grato abraço. Thank you very much!

Tenho agora o gosto de anunciar que todos os restantes membros da nossa Comissão se mantêm - nomeadamente o seu presidente, Prof. Axel Cleeremans. Mas também tenho o gosto de anunciar que a Comissão Organizadora do XV Simpósio Aquém e Além do Cérebro será reforçada com 3 novos elementos: o Prof. Chris Roe, da Universidade de Northampton, a Prof.ª Helané Wahbeh, da Universidade de Oregon e do Institute of Noetic Sciences, e a Prof.ª Veena Kumari, da Brunel University de Londres. Sejam bem-vindos!

Vivemos esta semana um dos momentos altos dos 30 anos da Fundação BIAL e esperamos viver outro momento alto no dia 9 de outubro, na Reitoria da Universidade de Lisboa, onde terá lugar uma grande conferência comemorativa e a entrega do Prémio Maria de Sousa 2024. Ficam todos convidados para esta conferência de 9 de outubro, às 17:00.

Mas também já vivemos um outro momento alto no dia 20 de fevereiro, aquando da cerimónia de entrega do *BIAL Award in Biomedicine 2023*, altura em que o Senhor Presidente da República, Prof. Marcelo Rebelo de Sousa, condecorou a Fundação BIAL como Membro Honorário da Ordem de Mérito. Expresso hoje, de novo, a nossa profunda gratidão pela

distinção com que o Senhor Presidente nos honrou. E faço-o em nome do Conselho de Administração da Fundação, ou seja, do Prof. Daniel Bessa, do Prof. Nuno Sousa, do Dr. Miguel Portela e da Prof. Patrícia Teixeira Lopes, aos quais também desejo manifestar o meu enorme agradecimento pela forma competente, diligente e apaixonada como estão na Fundação, na esteira do que também muito aconteceu com o Prof. Nuno Grande, o Prof. Manuel Baganha e a Prof. Maria de Sousa, que aqui recordo com saudade e homenageio pelos enormes exemplos que nos deixaram.

Mas permitam-me que também agradeça ao Conselho de Reitores das Universidades Portuguesas, na pessoa do seu Presidente, Prof. Paulo Jorge Ferreira, e à Ordem dos Médicos, na pessoa do seu Bastonário, Dr. Carlos Cortes, por todo o apoio que nos têm dedicado. O nosso agradecimento a todos os membros do nosso Conselho Científico, bem como aos membros do Conselho Fiscal. Muito obrigado.

E ainda uma palavra de reconhecido agradecimento à nossa Secretária-Geral, Paula Guedes, e a toda a sua pequena, mas muito eficiente Equipa: à Sylvie Marinho, à Sandra Pinto e à Carina Rodrigues. Muito e muito obrigado pela vossa competência e pela vossa grande entrega à nossa causa.

Eu disse em fevereiro que a condecoração de Estado que recebemos "constitui um grande estímulo a esta Fundação para continuarmos, cada vez mais e cada vez melhor, a procurarmos apoiar a ciência que se faz em saúde, a procurarmos contribuir para que as pessoas tenham mais e melhor conhecimento, mais e melhor saúde, mais e melhor vida". E assim é, de facto, um enorme estímulo.

Mas, deixem-me dizer-vos, a vossa presença aqui hoje e nos próximos dias, também é um bom estímulo para nós. Muito obrigado por terem vindo. Desejamos-vos um excelente simpósio. Usufruam!

Muito obrigado!

DISCURSO DO PRESIDENTE DA COMISSÃO ORGANIZADORA
SPEECH OF THE PRESIDENT OF THE ORGANIZING COMMITTEE

Axel Cleeremans

Welcome to Porto and to the Casa do Médico, which is once again hosting our event. My name is Axel Cleeremans, and I am a cognitive scientist working at the Université libre de Bruxelles, in Belgium. I have the honor of chairing the organizing committee of the Symposium Series of the BIAL Foundation, which is why I am speaking here tonight. It is truly a great pleasure and privilege to open the 14th Symposium, dedicated, as you know, to the fascinating process of creativity. It is hard to think of an ability that is more human than creativity, though we are not the only animals capable of creative thinking. The males of some birds for instance, such as the Vogelkop Bowebird of New Guinea, build elaborate and highly creative collections of shiny objects of different colors to seduce potential partners. But human creativity has brought us where no other animal has gone before - conquering space, mastering nuclear energy, building incredible architecture, but also producing amazing art of many different kinds, from music to cinema, from sculpture to literature. How does this work? What makes us so special? Is creativity something that one can learn? Are AI systems such as AlphaGO or chatGPT creative? And what are the outer edges of creativity? These are some of the questions we will attempt to address over the coming three days.

But before I give you an overview of the program itself, let me say something about how the symposium came to be. As you may know, this biannual event is organized by a scientific committee. And after each symposium, we get together again and start thinking about what the next symposium should be about. And thinking about that effectively requires a lot of different things. And first, it requires… creativity! It requires creativity and knowledge to imagine the most stimulating, timely themes, themes that will bring people to Porto and stay with us for three days.

And we think creativity is precisely such a theme - more on that later. Second, the work of the committee, and the symposium itself, is only possible through the support of the BIAL Foundation, and of Dr. Luís Portela in particular. In the name of the committee, thank you, dear Luís, for your continuous support, for your open mind, and for your energy driving all this forward for so many years, 30 years already, in fact. But third, the most important factor that makes the committee work so well is the people who sit on it. And I would like to express my gratitude to the excellent company of scientists and friends that I have the pleasure to work in with: Prof. Etzel Cardeña, from Lund in Sweden, Prof. Miguel Castelo-Branco, from Coimbra here in Portugal, Prof. Rui Costa, from Lisbon and the Allen Institute, Prof. Rainer Goebel, from Maastricht University in the Netherlands, Prof. Stefan Schmidt, from Freiburg in Germany and Prof. Caroline Watt, from Edinburgh in Scotland - thank you all for your continuing commitment to make this 14th Symposium as successful as I hope it will be. The work of the committee also benefits from the presence of BIAL Foundation board member Nuno Sousa. And special thanks to Caroline Watt, who leaves the committee this year, thank you so much Caroline! There are two further persons I should like to express my gratitude to. First, Prof. Mário Simões, from Lisbon, who will once again handle the oral poster presentations from BIAL Foundation grantees, thank you Mário for your enthusiasm and continued engagement. Second, of course, Paula Guedes, who, together with other colleagues from the BIAL Foundation, masterminded the entire organization once again this year. Thank you so much Paula for your diligence and efficiency!

So, what do we have in store for you this year? As always, our symposium is organized over three days, each dedicated to a different aspect of creativity: "The foundations of creativity", tomorrow, "The expressions of creativity", on Friday, and "The edges of creativity", on Saturday. Let me say a few words about each day.

Tomorrow, in a session moderated by Caroline Watt, we will first hear from Nicola Clayton and Mark Baldwin, who, in a unique collaboration between a scientist and a choreographer, will talk about movement and mental time travel in humans, but also in animals. Next, Christine Simmonds-Moore and Amory Danek will examine the links between

creativity and susceptibility to exceptional experiences and cognitive factors respectively. The morning will end with a keynote lecture by Anna Abraham, who will debunk some myths we entertain about creativity and explain why such myths persist.

On Friday, we have another amazing session which will be moderated by Rainer Goebel. Michael Hanchett Hanson, Lucia Melloni, online unfortunately, and Marilyn Schlitz will explore how creativity can be expressed in educational settings, in the conduct of science, and in artistic creation. The keynote lecture by Morten Kringelbach will close the morning with a focus on the neuroscience of music and on how music can lead to meaning-making and pleasure.

Finally, Saturday will be dedicated to the edges of creativity. Here, in a session moderated by Stefan Schmidt, we will hear from Sergio Neuenschwander, Frederick Barrett and Marcus du Sautoy on cinema, psychedelics, and artificial intelligence - that´s quite a program! And Edward Kelly's keynote lecture takes the bold step of questioning the status quo. He will seek to reenchant our understanding of creativity by assuming the primacy of consciousness - a form of idealism that he will argue for and defend.

So, that is our plan for the next three days and I would already like to express my gratitude to all the speakers for their … creativity and collaboration in helping us put together such a rich and diverse program. But that's not all! We also have a number of exciting events planned for the afternoons.

First, as you know, the BIAL Foundation not only organizes this symposium, but it also administers prestigious scientific prizes and funds fundamental research on a competitive basis - this is perhaps its most important activity. And the successful holders of BIAL grants are invited to present their work here, during the symposium, in the form of a poster presenting their achievements. And to make it more engaging, we will also have an exciting set of blitz presentations - two minutes each, it will be really short - moderated by Mário Simões, who has by now become a true master at keeping the time and the rhythm, with great humor, throughout the entire session. This session will take place here at 14:30 tomorrow. And if you like what you hear during that session, you will have an opportunity to learn more about the work in the poster session

that follows after the afternoon break.

Our second exciting event is the truly excellent set of workshops that we propose on Friday. The first workshop, organized by Miguel Castelo-Branco and featuring Tiago Martins in collaboration with Penousal Machado, is about creativity and artificial intelligence and it will involve hands-on experience and co-creation. So, you have to bring your laptop to that workshop!

The second workshop, organized by Rui Costa, features Nicola Clayton and Mark Baldwin again, but this time they will dance with you instead of talking! So, you have to bring your body for this workshop!

The third workshop is coordinated by Etzel Cardeña and will explore how one's sensory experience can itself be creative. Under the guidance of Christine Simmonds-Moore, the workshop will involve taking a short personality test, undergoing a brief hypnotic induction, and then expressing one's experience of different stimulations using drawing or sculpting. Bring an open mind to take part in this workshop!

And finally, the fourth workshop, imagined by Nuno Sousa, features the amazing Portuguese musician Pedro Abrunhosa who will explore, interactively with the participants, how to create music, starting from silence. So, don't forget to bring your mobile phone to take part in that workshop!

These four incredible workshops will be followed by a cheese and wine reception during which we will able to share our respective afternoon experiences.

And finally, we will close the symposium on Saturday afternoon with a concluding roundtable dedicated to come back to the fundamental question of understanding how creativity works. I will moderate this event, that will feature Nicola Clayton and Mark Baldwin, Marylin Schlitz, Sergio Neuenschwander and Pedro Abrunhosa. We will debate, interact with you, the public, and perform in an informal, engaging atmosphere intended to promote … creativity! This is it, and as you see, it is a lot. I very much hope, on behalf of the organizing committee, that you will enjoy the symposium as much as we enjoyed creating it!

Thank you!

DISCURSO DA VEREADORA DA CÂMARA MUNICIPAL DO PORTO

Catarina Araújo

Muito boa tarde a todos.

Queria começar pelos cumprimentos protocolares, Senhor Presidente do Conselho de Reitores das Universidades Portuguesas, Prof. Paulo Jorge Ferreira, Senhor Bastonário da Ordem dos Médicos, Dr. Carlos Cortes, Senhora Bastonária da Ordem dos Nutricionistas, Dra. Liliana Sousa, Senhor Presidente da Academia Nacional de Medicina, Prof. Duarte Vieira, Senhor Presidente da CCDR-N, Prof. António Cunha, Senhor Reitor da Universidade do Porto, nosso Magnífico Reitor, Prof. António Sousa Pereira, Senhor Diretor do IPATIMUP, Prof. Sobrinho Simões, Senhor Presidente da ARS Norte, Dr. Carlos Nunes, Senhor Presidente da Entidade Reguladora da Saúde, Prof. António Pimenta Marinho, caro Dr. Artur Santos Silva, Senhor Presidente da Comissão Organizadora da Fundação BIAL, Prof. Axel Cleeremans, Senhor Presidente da Fundação BIAL, Dr. Luís Portela, a quem tenho muito penhoradamente de agradecer o convite que endereçou ao Município do Porto para participar na sessão de abertura deste Simpósio. Meus senhores e minhas senhoras, sintam-se todos cumprimentados.

Queria começar por referir e distinguir a louvável missão e o trabalho da Fundação BIAL, que assinala este ano 30 anos de existência, permitindo descobertas e viabilizando atingir novos patamares de conhecimento que impactam, e estou certa de que continuarão a impactar, a saúde e o bem-estar dos indivíduos, particularmente no âmbito das Neurociências.

Ao incentivar o estudo científico do ser humano, tanto do ponto de vista físico, como espiritual, a Fundação BIAL tem vindo a apoiar aqueles que, de uma forma metódica e rigorosa, procuram inovar e abrir novos caminhos na área da investigação, da Ciência, do conhecimento, tanto em Portugal, como no mundo. De entre as distintas atividades promovidas pela Fundação BIAL, os Simpósios Aquém e Além do Cérebro reúnem desde 1996 a elite científica internacional das áreas das Neurociências e da

Parapsicologia num fórum de debate e atualização científica, que é uma referência mundial, dando palco aos mistérios do cérebro e do sistema nervoso, permitindo o reconhecimento de descobertas inovadoras, que nos capacitarão a todos para melhor enfrentar os desafios atuais neste âmbito. Desafios tais como, desde o aumento da esperança média de vida, concomitantemente com o aumento da carga global da doença, onde as doenças neurológicas encontram particular destaque, às oportunidades e desafios éticos em torno da Inteligência Artificial. Desafios que passam pela busca de novas soluções e respostas a necessidades, que vemos como emergentes, mas que há um par de décadas não as imaginaríamos nunca como tal. Representando uma área emergente do conhecimento, as Neurociências, que também têm beneficiado dos avanços tecnológicos que a todos impressionam, hoje mais do que nunca, desempenham um papel fundamental na compreensão do que está na origem do que nos distingue enquanto indivíduos, e que vai muito para além da informação genética, permitindo alavancar o tratamento de diversas condições e maximizar a atuação em outras. Este conhecimento permite-nos, por exemplo, criar formas de Inteligência Artificial que usam a capacidade de computação cerebral nas mais diversas e variadas tarefas e, longe de ser fechado, o campo de investigação neste âmbito é amplo e articula-se com inúmeras outras áreas, da Biologia, da Anatomia e da Química, à Educação e à Psicologia, tendo sempre o sistema nervoso e a sua relação com o meio interno e externo enquanto denominador comum. Os novos modelos concetuais destacam a forma como os processos biológicos, comportamentais e psicossociais acumulados ao longo da vida do indivíduo, influenciam a sua saúde e o risco de doença em idades mais avançadas.

Durante os últimos 20 anos, percebemos que o cérebro humano, mesmo após maturação, é muito mais mutável e adaptável do que originalmente se pensava, e há agora um novo olhar dirigido para a mente como um todo. A promoção da saúde, enquanto processo que visa criar condições para que as pessoas possam agir sobre os fatores que determinam a sua saúde, deve constituir-se num processo participativo, holístico, intersectorial, equitativo, sustentável e baseado em combinações de múltiplas estratégias.

O Município do Porto conhece a natureza multidimensional da saúde, entendendo que o planeamento das políticas e estratégias no âmbito da

promoção da saúde deve envolver diferentes atores ao nível local e acredita que os esforços conjuntos são os que impulsionam avanços significativos no desenvolvimento de intervenções eficazes. Com base neste pressuposto, o Município do Porto foi pioneiro e inovador na criação do seu Plano Municipal de Saúde. Este Plano foi pensado enquanto ferramenta estratégica de gestão, quer para identificar as necessidades em saúde no nosso território, quer para apresentar propostas de ação numa perspetiva, como nos competia, essencialmente preventiva. O seu Plano de Ação foi construído em torno de quatro eixos de intervenção: Crescer e envelhecer no Porto; Bem-estar emocional, psicológico e social; Alimentação equilibrada e Consumos. De uma forma muito sucinta, permitam-me que destaque apenas dois destes quatro eixos de intervenção.

O eixo "Crescer e envelhecer no Porto", que surge como resposta complementar a questões relacionadas com a promoção do envelhecimento ativo e saudável, desmistificando a ideia de que as atividades ligadas a esta matéria só são para pessoas mais idosas, focalizando a importância de envelhecer ao longo de todo o ciclo da vida, como determinante da melhoria da qualidade de vida. Neste eixo é também dada particular importância ao papel da literacia em saúde, numa perspetiva de maior envolvimento e responsabilização da pessoa nos seus percursos, com impacto positivo tanto na vigilância, como na promoção da saúde. A promoção da atividade física regular, rentabilizando os espaços existentes no concelho para a prática da mesma, é também um dos grandes enfoques, não esquecendo a fruição dos espaços de lazer culturais e desportivos.

Um outro eixo que me permitia sucintamente destacar, é o eixo do "Bem-estar emocional, psicológico e social". Este eixo visa também, de forma complementar, dar resposta à questão relacionada com a promoção da saúde mental, privilegiando o desenvolvimento das competências socioemocionais como pedra basilar, e desde a infância, sem esquecer a desmistificação e o combate ao estigma diretamente relacionados com a saúde mental. A tónica nas intervenções dinamizadas ao abrigo deste eixo encontram-se na prevenção e na atuação a montante, sem esquecer a otimização das respostas e de recursos comunitários existentes no âmbito da saúde mental. O estímulo à partilha de boas práticas e de conhecimento e à criação de sinergias entre áreas distintas do saber e da sociedade constituem pilares e princípios essenciais deste documento estratégico

municipal, que se quer interligado com outros e como promotor de um conceito de saúde, que é efetivamente um compromisso de e com todos.

Mas o Simpósio que hoje aqui nos traz é também exemplo claro deste fundamento. Nesta sua 14ª edição, promete explorar aquela que é a essência da inovação científica e impulsionadora da arte em todas as suas formas, a criatividade, desde as bases aos seus limites, passando pelas expressões da criatividade pelas diferentes formas de a estimular. De facto, nas bases e no estímulo à criatividade temos, entre outros, a expressão artística, o estímulo à fruição, à criação cultural. Desde a dança, aqui já mencionada, à arte urbana, passando pela dinamização dos diferentes recursos municipais, a cultura constitui, sem dúvida, uma aposta deste Executivo Municipal e do Senhor Presidente de Câmara, que particularmente desde o início assumiu a Cultura como um dos eixos e pilares basilares daquela que seria a sua governação.

Nestas bases, não podemos deixar de fora o importante trabalho desenvolvido no âmbito da promoção da saúde mental e da capacitação socioemocional dirigida a crianças e jovens, cujo investimento do município é também uma realidade. Neste sentido, acredito que estamos todos devidamente alinhados e envolvidos, procurando em conjunto resultados e sucessos em matéria de saúde e qualidade de vida, construindo respostas eficazes às necessidades da nossa população.

Não me alongo mais, mas permitam-me, ainda assim, novamente e publicamente, louvar a Organização pelo ambicioso programa de trabalhos. Concordarão certamente comigo quando digo que estamos perante um programa que é, também ele, o reflexo de uma enorme criatividade, comprovando a dedicação e o empenho da Comissão Organizadora em proporcionar a todos os que participam um leque rico e diversificado de temas de debate e atualização profissional.

Termino como comecei, Senhor Dr. Luís Portela, permita-me enaltecer, uma vez mais, esta notável iniciativa, na certeza de que, cada um dos que aqui estão presentes, sairá deste Simpósio ainda mais rico do que aqui entrou, levando consigo, mas também acredito podendo depois transmitir a outros, perspetivas que em muito enriquecerão a sua prática profissional.

Uma vez mais, muito obrigada pelo convite. É um gosto e uma honra poder estar aqui com os Senhores.

Muito obrigada.

DISCURSO DO BASTONÁRIO DA ORDEM DOS MÉDICOS

Carlos Cortes

Muito boa tarde a todas e a todos aqui presentes nesta Sessão de Abertura.

Em primeiro lugar, gostaria de cumprimentar a mesa, o Presidente da Fundação BIAL, Dr. Luís Portela - muito obrigada pelo honroso convite que me endereçou, que endereçou à Ordem dos Médicos -, e felicitá-lo pela organização deste evento. Para não repetir, cumprimento todas as instituições e personalidades aqui presentes nesta Sessão de Abertura.

Cumprimentar também o Presidente da Comissão Organizadora do 14º Simpósio da Fundação BIAL. *Permettez-moi de parler en français, vous êtes Belge, c'est plus facile. Je vous donne la bienvenue, Prof. Axel Cleeremans. Bienvenue au Portugal, à Porto et à l'Ordre du Médecins du Portugal. Merci beaucoup!*

Cumprimentar a Excelentíssima Vereadora, Dra. Catarina Araújo. A sua presença feminina era muito esperada nesta mesa. Muito obrigada. Mais uma vez nos encontramos na abertura de um evento, aqui, na magnífica cidade do Porto.

Finalmente, cumprimentar o Prof. Paulo Jorge Ferreira, Excelentíssimo Presidente do Conselho de Reitores das Universidades Portuguesas.

É com imenso gosto que, mais uma vez, estou numa iniciativa da Fundação BIAL, e quero aqui expressar a gratidão, em primeiro lugar, e manifestar também a forma como tenho ficado impressionado com aquilo que a Fundação BIAL tem desenvolvido a bem da Ciência, a bem da Medicina, a bem do desenvolvimento. Como Bastonário da Ordem dos Médicos tenho o gosto de responder positivamente à gentileza que têm tido em convidar a Ordem dos Médicos para estar presente nas várias iniciativas, nos prémios, nos Congressos que têm organizado ou, neste caso em concreto, do Simpósio. Fico verdadeiramente satisfeito, como Bastonário da Ordem dos Médicos, como médico, como cidadão, em perceber que a sociedade civil, que não tem a obrigação de o fazer desta forma, se entrega ao desenvolvimento do país, ao desenvolvimento

da Ciência, da Medicina, mas, sobretudo, com este grande objetivo de melhorar a vida das pessoas. E isso é magnífico. Nós percebemos muitas vezes quando os Governos, as várias instituições públicas, de alguma forma falham; independentemente das causas, nós temos sempre na sociedade civil quem acaba por se comprometer com a Ciência, se comprometer em desenvolver a Ciência no nosso país, e isso reconforta-nos a todos.

Mais uma vez, obrigada por aquilo que a Fundação BIAL tem desenvolvido ao longo dos anos e continua a desenvolver. O Prémio BIAL de Medicina Clínica, o BIAL Award in Biomedicine, no qual eu estive presente, um dos maiores prémios europeus na área da saúde, e o Prémio Maria de Sousa, que, com muito gosto, a Ordem dos Médicos abraçou, e irá continuar a abraçar, juntamente com a Fundação BIAL.

Queria também sublinhar o interesse do tema da criatividade, que já foi aqui bastante desenvolvido pelos meus antecessores nesta palestra. A criatividade acompanha-nos, a todos os seres humanos, desde o início da Humanidade, e tem acompanhado também o desenvolvimento da Medicina. Os primórdios da Medicina têm sido feitos num caminho comum com a criatividade, com a curiosidade do ser humano. E a criatividade nas suas várias formas. Muitas vezes quando falamos em criatividade limitamo-nos a pensar nas boas ideias que as pessoas têm, mas ser criativo não tem só a ver com boas ideias; aliás, a etimologia da palavra tem a ver com a concretização, com a criação. Criatividade tem a ver com criação, e são dois aspetos muito importantes em que, também a Fundação BIAL, de alguma forma, tem aqui expressado de uma forma brilhante: por um lado, criatividade na investigação, no desenvolvimento, criatividade na troca dos saberes, na troca do conhecimento, na sua divulgação, mas depois também ajudar à concretização desta criatividade. A Ciência é isto; concretizada naquilo que é uma mais-valia, que são ganhos na vida das pessoas, no bem-estar das pessoas, é muito importante. E nós estamos num tempo que apela, verdadeiramente, à criatividade. Nós estamos num tempo de incertezas, não só incertezas no mundo, mas incertezas aqui muito locais, no nosso país. Iniciámos ainda ontem um novo Governo, com muitas incertezas colocadas na área da Saúde. Todos nós sabemos que a área da Saúde tem atravessado imensas dificuldades; procuram-se repostas, procuram-se as soluções adequadas para responder a estas dificuldades e apela-se, também, à criatividade de todos nós.

Mais uma vez, e terminando esta minha curta intervenção, agradeço à Fundação BIAL tudo aquilo que tem feito, e continua a fazer, pela Medicina e pela Ciência.

Muito obrigado.

DISCURSO DO PRESIDENTE DO CONSELHO DE REITORES DAS UNIVERSIDADES PORTUGUESAS

Paulo Jorge Ferreira

Saúdo a mesa em primeiro lugar: Senhor Presidente da Fundação BIAL, Dr. Luís Portela, Presidente da Comissão Organizadora, Dr. Axel Cleeremans, Senhora Vereadora, Dra. Catarina Araújo, e o Senhor Bastonário da Ordem dos Médicos, Dr. Carlos Cortes. Saúdo também todos os Presidentes presentes, todos os representantes e Bastonários das Ordens Profissionais, o Presidente da Academia Nacional de Medicina, o Senhor Reitor da Universidade do Porto, que me precedeu na Presidência do CRUP, e que é um gosto encontrar aqui, os Senhores Presidentes da Entidade Reguladora da Saúde, da CCDR Norte, da ARS Norte e outros representantes da Administração Pública. Eu ficava por aqui, para não tornar demasiado fastidiosa uma lista que já foi, mais do que uma vez, repetida.

Ser-me-ia sempre grato comparecer neste ato, nesta abertura, mas é-me particularmente grato num ano que é particularmente grato para a BIAL, num ano de múltiplas efemérides: o centenário da fundação da BIAL, por Álvaro Portela, em1924, os 40 anos do Prémio BIAL e os 30 anos da Fundação BIAL, à qual o Dr. Luís Portela preside neste momento. Só isto, e haveria outras datas a mencionar, já seria motivo suficiente para estar aqui com acrescentada satisfação. Na verdade, a presença do Presidente do Conselho de Reitores nesta cerimónia justifica-se, também, por outros motivos.

A BIAL começou, em 1992, uma trajetória na qual passou a desempenhar um papel acrescido: a investigação, a inovação, a criação de conhecimento. Demorou quatro anos a registar a sua primeira patente e, a partir desse momento, entrou numa trajetória de consolidação, de afirmação, de crescimento, que a fez entrar num grupo restrito de entidades que, em vez de seguir, lideram; que, em vez de imitar, criam; que escolhem, traçam, percorrem o seu próprio caminho. E esta atenção à inovação, à inovação como motor do crescimento e da sustentabilidade do crescimento, acho

que é extremamente importante e que uma Universidade, como instituição que promove o conhecimento e a inovação, deve reconhecer, e que um Conselho de Universidades, também por uma maioria de razões, o deve fazer. Por isso, Senhoras e Senhores, acho que está inteiramente justificada a presença do Conselho de Reitores aqui, o seu patrocínio a este tipo de eventos e, tal como o Presidente que me antecedeu o fez, eu a este evento me associo, com muito gosto.

Sobre o Simpósio, o 14º, já falámos muito sobre ele. Eu não vou maçar-vos mais, mas vou contar-vos uma pequena história.

Como Reitor, interessa-me saber aquilo que pensam os empregadores que recrutam os nossos formandos, aqueles estudantes, aqueles diplomados que colocamos no mercado de trabalho. Que competências valorizam mais? O que é que para eles é mais precioso quanto a membros novos da sua força de trabalho? Não é a competência técnica; competência técnica é um dado quase adquirido, a atualização das mesmas é outra questão mais complexa. Uma das competências mais pretendidas, uma das qualidades, se quiserem, é a criatividade. Criatividade, capacidade de trabalho em equipa, capacidade de comunicação e uma série de outras competências interpessoais. E isto coloca ao Reitor, coloca às entidades, coloca às organizações, um obstáculo muito difícil, porque a competência técnica é fácil de transmitir, mas como se ensina a ser criativo? Como se ensina a comunicar e a trabalhar em equipa é mais fácil, mas a criatividade parece-me estar num outro plano. E se as Universidades quiserem ter resposta para esta solicitação, devem organizar-se de modo a promover ambientes onde seja estimulada a criatividade. E isso é uma coisa que eu acho que posso dizer que ninguém sabe exatamente como fazer. Por isso, a ideia deste simpósio e a lição que vamos ter a seguir, dedicada à criatividade e a alguns dos seus aspetos, me parece tão preciosa, tão importante e, por isso, tenho a certeza de que vou sair daqui sabendo mais do que sabia quando entrei.

Muito obrigada a todos.

CONFERÊNCIA INAUGURAL
OPENING CONFERENCE

CREATIVITY, INSIDE AND OUTSIDE THE BOUNDARIES OF THE MIND: A CO-CREATIVE DIALOGUE

Todd Lubart [*]

Creativity has traditionally been conceived as a lonely adventure, situated mainly in the human mind, which according to some received divine inspiration to produce great ideas and original productions of all kinds. This "lone genius" view is, however, far from most current reflections on creativity (Montuori & Purser, 1995).

In this paper, we will examine some contemporary understandings of creativity. The approach taken here is however somewhat different from the habitual one. Typically, a researcher writes a paper based on the existing scientific literature. Indeed, there is approximately 150 years, at least, of scientific work on creativity.

But times are changing, and it seems natural these days to start by asking our friend ChatGPT what it thinks about the subject. So, here we go. The prompt is: *Write a scientific paper entitled "Creativity: Inside and Outside the boundaries of the mind"*. Why this prompt you ask? Because it was the title of the talk I gave at the BIAL 2024 symposium, focusing on the topic of creativity. Here follows ChatGPT's answer, *in italics*. Then, I will be back for some remarks and additions based on my presentation at BIAL.

ChatGPT:

1. Introduction

Creativity is often regarded as a defining characteristic of human cognition, yet its definition remains elusive. Traditionally understood as the ability to generate novel and useful ideas, creativity spans disciplines, from the

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arts to science, and contexts, from individual pursuits to collaborative efforts. This paper seeks to unpack creativity, examining its internal workings and external influences, and to explore its applications across diverse domains.

2. The inner workings of creativity

2.1. Cognitive mechanisms

At the core of creativity lies the brain's ability to synthesize disparate ideas and form novel connections. Research highlights the interplay between the default mode network (DMN), associated with mind-wandering and idea generation, and the executive control network (ECN), responsible for refining and evaluating ideas (Beaty et al., 2016).

2.2. Neurochemical and emotional drivers

Creativity is influenced by neurochemical activity, particularly dopamine, which enhances divergent thinking. Emotional states also play a role: positive emotions are linked to expansive thinking, while negative emotions may encourage deeper analytical processing (Fredrickson, 2001; Kaufman & Gregoire, 2016).

3. Beyond the mind: External influences

3.1. Socio-cultural contexts

Creativity does not occur in isolation. The systems model of creativity (Csikszentmihalyi, 1997) posits that it arises at the intersection of individual talent, cultural domains, and social acceptance. Cultural norms and values shape what is considered "creative," with cross-cultural studies revealing significant variations (Niu & Sternberg, 2006).

3.2. Environmental factors

Physical spaces and collaborative environments also play a critical role. Studies demonstrate that open, resource-rich environments with minimal constraints foster higher levels of creativity (Amabile, 1996). Digital tools and networks further expand the boundaries of collaboration, enabling global creativity.

4. The feedback loop between the individual and the collective

Creativity often emerges through an iterative process involving individual ideation and collective validation. The "4Ps" framework of creativity - person, process, product, and press (Rhodes, 1961) - illustrates how internal and external elements interact dynamically.

5. Implications for education and organizations

5.1. Nurturing creativity in education

Educational practices must balance structured learning with opportunities for exploration. Techniques such as problem-based learning and fostering intrinsic motivation have been shown to enhance student creativity (Robinson, 2011).

5.2. Organizational innovation

Organizations seeking to foster innovation must cultivate a culture of psychological safety, reward divergent thinking, and encourage interdisciplinary collaboration. Google's 20% time policy and IDEO's design-thinking framework are cited as successful examples (Brown, 2019).

6. Conclusion

Creativity resides both inside and outside the boundaries of the mind, shaped by neural processes, individual traits, and socio-cultural influences. Recognizing the interplay between internal cognition and external context can enhance our understanding and application of creativity in education, organizations, and beyond. Future research should explore emerging technologies and their potential to redefine the boundaries of human creativity.

Reply

Thank you ChatGPT. As a generative artificial intelligence system that has access to essentially everything on the internet, the answer that you provided is meaningful, and connects with the existing literature. However, it seems useful to add a few concepts and highlight several points.

1. Introduction

First, the standard definition of creativity indicates that creativity is an ability to produce work that is both novel-original and valuable-appropriate (Runco & Jaeger, 2012). Novel refers to the fact that a hallmark of creativity is the original nature of the work; at least the work needs to be original for the producer (e.g. a person or group). In addition if the work is new for the larger public, originality is established with respect to socially-determined benchmarks. The value, or appropriateness criteria for creative work refers to its meaningful nature. This value is appreciated by the initiator of the work or by others who see the work. Thus, there is an inside the mind, and outside the mind aspect to the definition of creativity itself. We can look at the novelty and value of a production for the creator (him or herself), and the novelty and value for others, the larger social unit. It is worth noting that the standard definition was recently updated to include the idea that creative work requires intentionality (the desire to create new work) and authenticity (the creative process was truly engaged to produce the new work) (Runco, 2023).

2. Inner workings of the mind

In our work over the past three decades, we have developed a multivariate investment approach to creativity (Lubart, 1999; Sternberg & Lubart, 1995, 2003). According to this perspective, there are assets of "ingredients" that contribute to creative potential. This potential can be activated, thereby engaging the creative process, the act of making. Then, a production results, which is more or less novel, original, valuable and appropriate for the creator and the social group.

The "internal" ingredients that contribute to creative potential are (1) cognitive abilities, such as mental flexibility, associative ability, inductive reasoning, (2) conative factors such as personality traits like risk taking and openness, motivation to create, and preferred work styles like intuition-based search, and (3) affective or emotional factors, such as positive and negative mood state or having a rich emotional life. A large body of work has shown the positive link between these ingredients and

creative output. In addition, there is one more type of ingredient, the environment.

3. External influences

The environment has both physical and social facets. It may stimulate or hinder the expression of the internal ingredients. In addition, the environment through social context also serves to evaluate productions as more or less creative.

Tools are part of the environment. Each tool has affordances, and a tool can facilitate certain actions or kinds of thinking (Glaveanu, 2013). For example, sticky notes facilitate writing down short ideas and clustering them on a wall or table. In the past years, our team has been investigating multi-user virtual reality systems, such as Second Life, GLUE, and others in which people are represented by avatars and collaborate in a virtual space. We have studied how different "meeting rooms" can facilitate creativity, and the extent to which having a creative looking avatar is beneficial for creative thinking. There are effects of both of these, showing that people can get more ideas, as well as more original ideas under the right virtual settings, and with creative looking avatars (Bourgeois-Bougrine et al., 2020). In fact, virtual reality offers conditions that are difficult to provide in regular physical settings, such as having a meeting under the sea, or on the moon, and rendering all the participants anonymous so there is reduced social pressure or self-image management issues (see Bourgeois-Bougrine et al. 2022).

Other tools that are emerging offer further affordances for creative work. Notably, there is generative AI. Generative AI systems offer the possibility to propose ideas based on their rich database, allow users to go back and forth through refined prompts to get ideas, texts, images, and other productions refined to fit the human's creative vision (Rafner et al., 2023). A growing body of research suggests that people show enhanced creativity when they use generative AI systems, in particular those people who have a limited creative capacity. This is a case of tool use by humans to create but it also blurs the boundary between an environmental support system to facilitate an individual's creative thinking and creative collaboration, as the generative AI system becomes in some cases an

alter ego, another agent that interacts with the human. When trained, Generative AI systems can also offer judgments of new ideas in a given task context, thereby contributing to the "social" evaluation of creativity (Beaty et al., 2022).

4. The feedback loop between the individual and the collective

Creativity happens at the interface between a producer (an individual or a group) and a receptive audience (the social others) (Glaveanu et al., 2020). There is an interactive back-and-forth between an individual and the environment. For example, in the basic composition of the creative act, there is production and appreciation. Most of the time, this means there is a contribution from the inside individual mind to conceive an idea, and from the outside world thought space (the social mind) that interprets the meaning, value and significance of the work.

According to the sociocultural approach to creativity, the feedback loops are very important, and there is a dynamic system between the person and environment. This is the case for ideas that have a life of their own, when they leave the hands of the creator's workshop, enter the public domain, are modified by the receptive public, and then reworked later by the creator. This can be illustrated through the case of Harley Davidson motorcycle design, in which the Harley Davidson company produces motorcycle models, customers modify and customize their motorcycles, the company notes these contributions and later integrates some into new Harley models.

In its' reply, ChatGPT refers as well to the 4 Ps of creativity (Person, Process, Press, Product) in terms of internal and external factors that interact dynamically. The 4 Ps was expanded in a recent framework called the 7C approach (Lubart, 2017). It includes Creators (characteristics of creative people – internal factor), Creating (creative process – internal factor), Context (Press, creative environment – external factor), Collaboration (shared work between an individual and others, or an individual and a technological agent-tool, both internal and external factors), Creation (creative product's characteristics – external factor), Consumption (the adoption and extension of creative products – external), and Curricula (training and developing creativity – internal and external factor).

5. Implications for education and organizations

The main implications for both educational and organizational (work) contexts are that we cannot really boost creativity and facilitate it's' development if we focus only on either the part that is in the mind or the part that is outside the mind. In particular, creativity training programs in school or business settings will not alone be enough. These programs tend to train skills that contribute to creative potential, offer growth opportunities to build capacity and often provide techniques that help structure the creative process (Barbot et al., 2018). However, this approach is only partial, because it looks at one or more person-centered ingredients. In a similar way, enhancing the environment, physically through stimulating "creative" workspaces or socially through rules or activities that enhance environmental social stimulation will not be enough either. Thus, the integrative approach proposed here, both inside and outside the mind, requires joint interventions to be successful. This means that we need to diagnose the elements that are most worthy of attention in both the internal (person or group) and external (environment). This requires tools for assessment of ingredients and processes engaged using the ingredients.

6. Conclusion

This contribution illustrates the inside and outside dialectic that helps conceptualize creativity in our contemporary world. It is an example of a co-creative process. To start, there was the goal to produce a contribution to the symposium. This led to the human-based conception of the main ideas to convey to the public at the Bial symposium in Porto, 2024. Then came a phase of internet search, using google images, to find relevant illustrations. Thus, an internal ideation process relied on an external, environmental resource- the internet – to get images for PowerPoint. This led to revisions in the concepts to be conveyed and the related text of the slides, as some images were evocative and stimulating beyond the initial conception. The google search engine served as an environmental actor in the process. After the symposium, a long incubation phase started in search of the best way to turn the oral presentation into a

related text, illustrating in a conference paper format the main idea of creativity occurring both inside and outside the mind. The resulting idea was a contribution that stems from creativity both internally, through reflection, and externally through contributions from an outside agent, namely ChatGPT. This creative mode was termed "co-creation" in a manifesto on AI and creativity (Vinchon et al, 2023). It is an emerging trend in creative problem solving and serves as a closing point for this contribution.

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PALESTRAS
LECTURES

THE MOVEMENT AND MUSICALITY OF MENTAL TIME TRAVEL

Nicola Clayton [*] ***& Mark Baldwin*** [*]

Mental time travel refers to the subjective experience of recalling the past and imagining the future. It is about projecting the self in time, reflecting on where we have been and where we are going in space and time. Memories are not fixed repositories of the past but move in flexible ways because they evolved with the future in mind. We explored these concepts scientifically and artistically through our joint interest in choreography, the ways in which we explore the movement and musicality of wordless thoughts in humans and in other animals with whom we share the planet and its implications for creativity.

So why collaborate? Working together to produce something greater than the some of its parts. Things arise out of working together that could be the beginning of a new idea, thought, even culture. A big bang.

We have been collaborating together for over 15 years and the topics are diverse and yet there are surprising parallels and unexpected connections that inspire creativity: corvids (the crow family that include jays, magpies, rooks and ravens), cognition (our ability to reflect on how we think and how we evaluate what we think we know), wings and arms, with and without hands (for example, cephalopods, like us, have hands, but unlike us, they do not have opposable thumbs and we do not possess tentacles). Perhaps the common denominator is wordless thoughts: they crop up everywhere in the choreography of life and in a variety of non-human animals as well as humans.

We have given a number of talks and demonstrations together on the topic of mental time travel, and some of these also include exerts from choreographic works that Mark has created, inspired by our collaboration and explorations about such ideas. One example is pictured below in an event that took place at the Royal Society entitled "Darwin meets dance"

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to commemorate our first decade of working together, highlighting some of the themes that we have used. For example, same yet different, conceal and reveal, and the relative nature and subjectivity of time were the three core ideas that inspired Mark's creation of *Comedy of Change*, a choreographic work celebrating Darwin's bicentennial and the 150th anniversary of Darwin's most influential book "On the Origin of the Species".

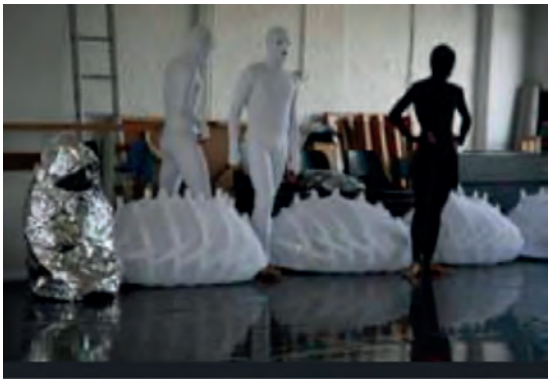

Figure 1. Comedy of Change. A rehearsal picture of Comedy of Change for Rambert Dance Company in London. Design: Kader Attia and Georg Meyer Weil. Music: Julien Anderson. Choreographer: Mark Baldwin OBE. Scientific Advisor: Professor Nicola Clayton FRS.

Also featured were exerts from some of Mark's other chorographic works that we collaborated on such as *What Wild Ecstasy*, which featured social wasps that represented haplodiploidy and its wider implications for sexual conflict, and Seven for a Secret Never to be Told, which included movements and images inspired by our discussions on child development and the cognitive abilities of corvids.

Figure 2. Darwin meets Dance performed at the Royal Society in December 2018.

Working together over such an extended period has allowed us to explore our ways of working and how we can integrate them together using the commonalities in our backgrounds as well as the obvious differences in our skill sets and experiences in many ways. Some of key ideas are illustrated in our book Movement in Mind, which has yet to be published but is shown below.

Figure 3. Pages from *Movement in Mind*.

What does these ways of working with wordless thoughts say about the human condition? How do these ideas manifest in both scientific and artistic practice either together or separately. We have chosen to

bring them together since our special interest is choreography. Wordless story-telling, sequences and phrases to mental time travel and back again enabling us to transcend the presence. To get into flow, where the brain and body amalgamate…. to become one. Where time and space no longer seem to matter and one is lost in the moment. These are the messages we wished to share with you in our lecture demonstration.

Workshop "Choreography and Embodiment: Creating with and without wings and tentacles to develop movements with and without words"

Activating the brain and body so that this meeting of corporal and cerebral minds results in an automatic response is sometimes called improvisation. This territory can be difficult to reach but we will guide you through some simple tasks to help you connect with your inner improvising self.

Make it up,
Make mistakes,
Make movement.
Make it your own.

"Blasted with ecstasy…" (Shakespeare's Hamlet, Soliloquy from Act III, Ophelia).

Nicky and I call ourselves Movement Junkies. For the past 15 years we have given talks and worked together on a number of dance projects driven by that most abstract of destinations, choreography.

Figure 4. The Movement Junkies Mark Baldwin OBE and Nicky Clayton FRS.

Dance is a wonderful way to bring the humanities together as it requires collaboration between visual artists for sets and costumes, lighting designers to illuminate the space and give mood, atmosphere, situation. And finally music, our best friend. Music for me is a great trigger, allowing the brain to travel backwards and forwards in time (and space) in what can feel like a split second. It is the supple bodies and brains of dancers that allow them to integrate with a choreographer, exploring themes, learning movement phrases, steps even sensations and emotions. Whilst touching on these topics the workshop is devised to open up some of these areas. It was a delight to teach at the Symposium and from what I could tell the participants enjoyed themselves and perhaps learned a little something to think about. Certainly, from my point of view they seemed very engaged. I have taught professional dancers for many years but it was spending time with mental health children in a special school that focused my teaching practice to keep it progressive, simple and I hope interesting. The workshop helps release our natural sense to invent and create in groups and as soloists, a sense of play with performative qualities, we know that all the big-brained animals play as youngsters and adults, if we think about crows throwing themselves down a snowy bank or skying across the ice on a bottle top. The fundaments of chiming together in rhythm as humans gives me a sense of the embodiment of our ancestral past.

Dance is a great way to explore abstraction and musicality (whatever that means for you). Also, dance is very good at notions of transformation taking us beyond the body. Thinking about the other animals we share the planet, such as birds with their other dimensions as they can fly almost weightless with their hollow bones, and cephalopods whose neurones are spread throughout their bodies (with more than twice as many neurones in their arms than their donut shaped brain,) enabling them to blend into background(s) incorporating delicate weather shifts simultaneously. This imagery can inspire all kinds of ideas for movement, musicality, and the ways in which we engage in mental time travel, the stories - fact and fiction, subjective and object - that we tell ourselves and share with others and share within ourselves through our memories of who we and others are.

Figure 5. Wordless story telling through dance at the BIAL Foundation event.

Figure 6. Exploring mental time travel: space, time, our identity through movement, and how we do so both individually and as a team, when divided into groups, given 'tasks' to respond to.

CONNECTIONS, SENSITIVITY AND TANGIBLE REPRESENTATIONS: UNPACKING SOME CORRELATES OF CREATIVITY AND PSI EXPERIENCES

Christine Simmonds-Moore [*]

Abstract

A collection of neural, perceptual, and cognitive attributes contribute to creativity and tendencies toward a range of psi experiences, including ostensible psi phenomena. A common correlate to both psi experiences and creativity is synaesthesia, which lends insights into the nature of both psi and creativity. These variables share a set of attributes that includes a plastic, connected (disinhibited) nervous system for the mind and body (enhanced connections); increased psychological and physical sensitivity to a range of internal and external stimuli and sources of information, and a greater influence of information that is usually outside of conscious awareness and at the edges of attention. This type of system also tends toward syncretic tendencies that enable tangible representations of ideas, stimuli, and information that may not usually be consciously available. Intriguingly, there seems to be an interplay between individual differences, states of consciousness, and other factors in terms of creativity and exceptional experiences. Variables of interest include synaesthesia, transliminality, Hartmann's boundary thinness, positive schizotypy, interoception, and ASMR (Autonomous Sensory Meridian Response). It is also the case that systems in which one can dip in and out of connected states (indicative of metacognition) may result in more genuinely creative outputs and the availability of ostensible psi phenomena. In addition, these systems may relate to systems rich in fractal signatures and which exhibit metacognitive traits, including control and cognitive organization.

Keywords: psi, creativity, synaesthesia, sensitivity, connections, representations, metacognition.

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In this paper I will discuss some common correlates of psi experiences, psi performance in controlled experiments, and creativity. I will focus on how synaesthesia, synaesthetic experiences, and the idea of the *synaesthetic disposition* (Ward, 2019) can shed light on our understanding of psychic experiences, psi and creativity. These correlates essentially rest on the idea that there are individual differences in tendencies toward sensory sensitivity, tendencies toward making connections within the system and between the person and the environment, in addition to tendencies to represent information in a concrete, innovative and accessible manner. Metacognitive factors will also be discussed as they help us to distinguish between those who are swamped by their experiences and those who are able to exhibit control and application of their experiential insights for creativity and psi experiences.

Definitions

Psi experiences and Psi phenomena

The full range of human experience includes subjective experiences in which people report anomalous access to information, anomalous interactions with matter, and anomalous experiences concerning the relationship between the mind and the body. These experiences are known more colloquially as extrasensory perception (ESP), psychokinesis (PK) and experiences suggestive of a separation of consciousness from the physical body including out-of-body experiences and ghost-type phenomena (the "survival hypothesis"). These experiences are commonly reported throughout history (Cardeña et al., 2017) and are present cross-culturally (Maraldi & Krippner, 2019).

Such experiences are labeled as psi, which reflect "anomalous processes of information or energy transfer (e.g., telepathy or other forms of extrasensory perception) that are currently unexplained in terms of known physical or biological mechanisms" (Bem & Honorton, 1994, *p.* 4). More recently, Vernon describes psi as "some form of interaction between the individual and the environment, or between one or more individuals in which it seems that some form of information and/or influence has occurred which cannot be explained in terms of current understanding of cause and effect" (Vernon, 2021, *p.* 1).

Regardless of the ontological status of these experiential phenomena, it is important for psychologists and parapsychologists to study the circumstances under which they occur, and individual differences and other correlates in order to understand them more fully. Research has systematically and critically examined psi experiences in terms of their psychological correlates, from a qualitative perspective, and in terms of whether an anomalous process of information transfer occurs. In the latter, experiments are designed in which, there is careful control of extraneous factors. Statistical anomalies (i.e., observations that differ from chance) are referred to as psi (or Ψ). This is akin to x in a mathematical formula and represents the anomaly in a neutral way. In due course, experiments that demonstrated psi effects should be replicated to see if they are genuine, and researchers should engage in theorizing regarding the best way(s) to understand them.

Research indicates that there is consistent support for psi phenomena (Cardeña, 2018), where meta-analyses indicate that certain paradigms consistently find above-chance results supportive of psi (e.g., the ganzfeld, remote viewing, presentiment studies, mediumship, among others).

Several lines of evidence support the notion that anomalous information transfer may first register in the physiological system and be available but not (necessarily) conscious. At a second stage, the information may be moved into preconscious and conscious awareness. This aligns with subjective paranormal experiences in which there are a number of different ways in which people can experience psi phenomena. For example, L.E. Rhine (2018) noted that intuitive and hallucinatory forms of ESP tend to occur when people are subjectively awake but do not provide much information regarding the event that the experience seems to refer to. Intuitive experiences, in particular reflect instinctual or compulsive feelings (high compulsion) without any detail (low completeness). In the context of dream-like states, imagery plays a stronger role and detailed information is seemingly conveyed that seems to align with real-world (non local) events (realistic forms of ESP). Detail is sometimes provided symbolically in dream like states.

The *two-stage* idea is supported empirically. There is evidence that psi is more likely to occur in the context of altered states of consciousness (Cardeña, 2020) and at the edges of attention, suggesting that it might

usually be filtered out of awareness (Holt et al., 2020). It is also better measured physiologically (Radin & Pierce, 2015) and in terms of a range of implicit measures, including behaviors and mood (Palmer, 2015). One influential model for psi is Carpenter's First Sight model (e.g., 2004). Here, psi phenomena are primary, and serve to orient the organism toward or away from stimuli and experiences that they will encounter in their spatially and temporally remote conscious experiences.

Creativity

Lubert and Thornhill-Miller (2020) have articulated seven different types of creativity, in their "7C" approach. Creativity can be understood in terms of creative individuals (the person level), the creative process itself, how people work together to co-create something, contexts for creativity, the creative work itself (or creations), the ways in which creative products are consumed and finally how creativity might be developed or enhanced. In this paper, I will primarily focus on creative individuals and the creative process in terms of their shared variance with psi phenomena and how traits associated with synaesthesia may help us to understand both.

At the person level, we can think of creative individuals in terms of those who are working in a creative profession, such as artists, musicians, poets, etc. (big C creativity). However, we can also think about those who might use creative thinking in a more every day context (little c creativity). Lubart and Thornhill-Miller note that there are different ingredients at play in the context of individual level creativity. This includes cognitive factors that allow for original ways of thinking and traits that relate to personality, thinking styles and different forms of motivation that contribute to original thinking. In summary, people may differ in terms of their *creative potential*, which is based on a number of interacting factors and traits (within a wider social context), including flexibility of thinking, knowledge within a particular area, individual differences in risk taking, and tendencies to experience the world in unusual ways (idiosyncrasy), among others (see Lubart & Thornhill-Miller, 2020).

Creativity as a *process* reflects a complex set of activities that underpin the production of innovative or novel ideas and products or solutions to given problems (see Lubart & Thornhill-Miller, 2020). It involves both divergent and convergent processes, where divergent thinking relates to

flexible and associational thinking, and convergent thinking relates to coming up with innovative solutions to a given problem. In addition, there is also a process of evaluation that is implicated in creativity, where the ideas are explored in terms of their value and potential for application (Lubart & Thornhill-Miller, 2020). Creativity is also purposeful and is usually aligned with a particular goal that is meaningful (at either a personal or social level). Different cognitive processes are implicated in the different forms of creativity, and there may be a dynamic interaction between different modes of thinking with regard to creativity (Girn et al., 2020). Different forms of creativity relate to different types of memory (Gerver et al., 2023), different states of consciousness, and different types of attention (Rebecchi & Hagège, 2022). Gerver et al. have also noted that the *cognitive control* of memory processes plays an important role in creative thinking (Gerver et al., 2023). This is revisited in the final section of this paper.

Creativity and psi experiences

Creativity and the creative process share a lot of variance with psi experiences. This is noted in Greek mythology, where the daughters of Zeus and Mnemosyne were the nine muses who were understood to inspire learning and the arts, in particular, poetry and music. Persinger (Persinger & Makarec, 1992) empirically explored the idea of the muse, and found that creative experiences were often associated with feelings of a sensed presence (aligned with ideas of the muse) among members of the general public. These experiences seemed to be associated with periods of intense meaningfulness that correlated neurologically with bursts of temporal lobe activity.

There are many examples of a shared variance between the creative processes and accessing inspiration and information beyond the self. Such information may often be experienced as deriving from an external source and is felt to be psychic, which correlates strongly with dissociative processes (Wahbeh et al., 2018). To date, there is statistical support for psi in the context of mediumship (Sarraf et al., 2021), but the source of psi debate remains at an impasse. In the context of mediumship and channeling, the experience might subjectively feel like it derives from an entity or intelligence outside of the self. In the context of genius and creativity, it might seem as if the works are already written and are being downloaded.

Even where there is no evidence for the ontological reality of a purported channeled entity, the creative outputs can sometimes be highly valued (Braude, 2000). This can be seen in the production of several forms of creative works in the context of mediumship and channeling experiences. One example of note is in the channeled writings of Pearl Curran who wrote acclaimed fiction as Patience Worth (Braude, 2000). Another example is the Brazilian medium, Andrade, who produced several artistic works (often simultaneously) in the style of the great artistic masters in the context of a mediumistic trance (Hageman et al., 2010).

Creativity also tends to correlate with subjective psi experiences (Holt, 2007). This seems to rest on emotional creativity, heightened internal awareness, intuition, and tendencies toward dreaming, daydreaming and hypnagogia, rather than measures of divergent or convergent creativity (Holt et al., 2004, cited in Holt, 2013). Holt notes that the aspects of being creative that seem to relate to psi experiences appear to rest on being open to experience and exploring the internal world, with a particular focus on affect and mental imagery. In terms of laboratory psi studies, measures of creativity also correlate inconsistently with psi performance, but those who work in creative professions tend to do better at free-response ESP tasks[1] (*cf.* Holt, 2013). Research has found that those working as artists, in particular, tend to perform better. This has often been observed in the context of the ganzfeld paradigm, which includes an altered state induction that facilitates an internal attention state where imagery and affect can be explored (Jenkins, 2015; Watt et al., 2020). A recent pre-registered study pre-selected creative individuals to participate in a ganzfeld precognition study (Watt et al., 2020). In alignment with the study predictions, the study found a significant hit rate (37%; p = .03, 1-tailed) supporting an enhancement of the psi process among creatives. Another study explored psi performance among artists using an experience sampling method[2] and found a 43% hit rate among artists that was statistically significant (Holt, 2013).

[1] Where the participant does not know what the target and decoy choices will be. Often, target sets are comprised of images or video clips organized into orthogonal sets that will later be blind judged against the person's impressions.

[2] This allows participants to engage in an experimental psi task out in the world, rather than in the context of a laboratory.

The contribution of synaesthesia

Synaesthesia is an important variable for understanding both creativity and psi experiences. Although synaesthesia is often defined as a condition associated with the fusion of senses, I define these experiences as those which occur when an inducing stimulus results in the usual response in addition to a second (or concurrent) response (Grossenbacher & Lovelace, 2001; Simner & Hubbard, 2013). For example, in my own research with "Harry" (in Simmonds-Moore, 2016), his experience of time was directly associated with the concurrent experience of colours, such that each day of the year was associated with a unique colour. In addition, Harry reported other synaesthesias, including colours for musical notes and musical genres as well as colours for mathematical equations that could be downloaded in terms of meaning.

Congenital or *strong* synaesthesia is reported by approximately 5% of the population. This refers to experiences that are automatic and consistent and which have been experienced since childhood (Simner & Hubbard, 2013). Indeed, it is generally accepted that these life-long synaesthesias are "highly *specific* experiences that are *consistent* within individuals (i.e., repeated presentations of an inducer will reliably elicit the same or a very similar concurrent experience, even over long intervals of time), and which are not under voluntary control (i.e., they happen *automatically*)" (Schwartzman et al., 2019, *p.* 2). In addition, synaesthesia is usually a unidimensional experience (the inducer influences the concurrent experience rather than the other way around), but there are exceptions. There are diverse ways in which people experience their additional concurrent experience. For some synaesthetes, the concurrent is "projected" out into space, while for others, the concurrent is experienced in the "mind's eye" or as a "knowing" (Alvaraz & Robertson, 2013). There are also other ways of experiencing as well, including in and around the body (Eagleman, 2012). Congenital synaesthesia has a genetic component and tends to run in families (Barnett et al., 2008). This appears to relate to an increased tendency to have neural connections (equivalent to neuroplasticity) which then interacts with learned linguistic and other cognitive and semantic information that is encountered during childhood development (Newell & Mitchell, 2016; Simner, 2012) (see later discussion on connections). Synaesthesias should therefore be

understood as complex interactions between neurobiological individual differences and experiences. This tendency results in idiosyncratic associations, even for the same form of synaesthesia. For example, even when a parent and child both experience the most common form of synaesthesia - i.e., grapheme-colour synaesthesia (in which letters of the alphabet are associated with specific colours) - the specific combinations are frequently unique for each individual.

There are multiple types of synaesthesia which are usually described in terms of the inducer-concurrent pairing. They range in terms of the nature of the pairings, with many inducers being sequence based (such as numbers, musical scales, time) and some concurrent experiences reflecting lower-level features (such as colours), while others are higher level (semantic) associations. Recent research has found that different types of synaesthesias tend to cluster together within individuals (Ward et al, 2022). In Ward et al's study, seven different synaesthesia clusters were identified; language-colour, language-taste; personification[3]; visualized sensations; sequence-space[4]; language-touch, and synaesthesia with smell/taste as concurrent experiences. Some forms of synaesthesia did not fit into clusters (including mirror-touch[5], hearing-motion, and tickertape[6] synaesthesia). Intriguingly, if a person has one form of synaesthesia, this increases the likelihood of them also having other forms. In addition, the number of clusters seemed to relate to other attributes, including vividness of mental imagery and sensory sensitivity (discussed in a later section).

Synaesthesia can also be *acquired* via neural damage among those who were not congenital synaesthetes (Grossenbacher & Lovelace, 2001) as in a recent case study (Abou-Khalil, & Acosta, 2023). This is transient in some cases, but permanent in others. For example, a recent case study noted the emergence of synaesthesia following the consumption of a

[3] This reflects the experience of having personalities or genders for ordered sequences such as numbers and letters, but this can also occur in association with objects.

[4] A common example is time-space synaesthesia where time is experienced in a spatialized manner.

[5] This occurs when a person experiences the pain or touch of a social other when that person is touched or experiences pain.

[6] This occurs when a person experiences words appearing in print in front of them when they are spoken as if being printed out in space.

psychedelic substance (Yanakieva et al., 2019).

Some forms of synaesthesia have also been reported to emerge temporarily among those who are not congenital synaesthetes[7]. This has been noted in several altered states of consciousness, including meditation (Walsh, 2005), hypnagogia (Sagiv et al., 2011), hypnosis (Cardeña, 2005), and via the ingestion of psychoactive substances (Luke & Terhune, 2013). In a similar vein, there is also some evidence that synaesthesia can be trained and emerge via learned pairings between an inducer and a concurrent (*cf.* Schwartzman et al., 2019). I return to this later, in our discussion of a *synesthetic potential*; the idea that synaesthesias might be more likely to emerge contextually among those with a certain neurobiological system that is indicative of the synaesthetic disposition.

Finally, synaesthesia-like experiences can also occur *weakly* in the context of creative cognition, metaphors, and cross-modal mapping (e.g., Marks & Mulvenna, 2013). For example, we can see synaesthetic-like thinking in metaphors (e.g., "I feel down today" or "that lemon is sharp"). Authors differ in terms of their acceptance regarding the equivalence of these different ways of experiencing synaesthesia.

Synaesthesia and Psi

The association between synaesthesia and psi phenomena has been pondered since Myers (1903-1904) noted that synaesthesia might contribute to psi and psi experiences by facilitating an unusual connection between the living person and his or her physical and transcendental environment. Cytowic (1995) found that synaesthetes experience a lot of unusual experiences including psi phenomena, including experiences of déjà vu, clairvoyance, precognition (in dreams), sense of presence, empathic healing and psychokinesis. Others have claimed that synaesthesia may underpin anomalous experiences as a kind of "building block" (e.g., Alvarado, 1994; Irwin, 1999; Williams, 1997).

May has noted that the remote viewers he has worked with tend to be synaesthetes and his multiphasic model of precognition has synaesthesia as a core component in psi process (Marwaha & May, 2015). Our survey study found that synaesthetic tendencies correlate with subjective

[7] These synaesthesias are different to those observed in congenital synaesthesia.

parapsychological experiences as well as general tendencies toward reporting anomalous experiences (Simmonds-Moore et al., 2019a).

A related phenomenon, Autonomous Sensory Meridian Response or ASMR[8] has been found to be strongly related to synaesthesia and may reflect another form of synaesthesia (Poerio et al., 2022a). Recent research has found that ASMR correlates positively with psi experiences (Simmonds-Moore, 2022a). In terms of specific types of experience, one survey found that synaesthesia was correlated positively with aura vision (Zingrone et al., 2009). The authors note that this provides "support for the idea that the visual experience of an aura may be related to the transformation of information from a particular sensory modality, or from vague emotional impressions into perceptions of lights or luminous fields" (*p.*162). In turn, although aura vision experiences were less commonly reported than other forms of psychic experiences, it seemed that if one experiences auras, they are more likely to experience the full range of subjective paranormal phenomena. Another paper (Ramachandran et al., 2012) found that there appeared to be a *systematic* transformation of emotions into a colourful aura that was experienced as being projected around the face and body of the other person. However, another study found that aura perception and personality-colour synaesthesia may actually be qualitatively different phenomena (Milan et al., 2012).

Synaesthesia is also at the heart of Irwin's (1985) model for out-of-body experiences, in which synaesthetic processes fuse a representation of a separated sense of self (occurring via dissociative processes) with strong visual imagery, resulting in the feeling of being outside of one's body. Other research supports a synaesthetic explanation for out-of-body experiences (Terhune, 2009). In addition, synaesthesia has also been implicated in the etiology of apparitions and haunting phenomena in association with somatic focus and hyperaesthesia (a form of sensitivity, to be discussed later in this paper) (Houran, Wiseman, & Thalbourne, 2002).

Our research (Simmonds-Moore, 2019) found that synaesthetes differed from non-synaesthetes in terms of the number of reported ghost

[8] This is the experience of a tingling sensation that originates in the scalp and is felt to move down the body, in response to a range of stimuli.

experiences with a paranormal attribution (but there was no difference for those that were given a mundane attribution). In a phenomenological study, synaesthesias were found to contribute to auras and precognitive dreams, in addition to the capacity for representing emotions and abstract information (that seemed to contribute to savant-like abilities) (Simmonds-Moore, 2016). These patterns suggest that synaesthesia may contribute toward the recipe for exceptional experiences, which essentially represents sensory or conceptual information in terms of another; a different way of experiencing aspects of the world that may not usually be tangibly experienced (see Simmonds-Moore, 2022b). In terms of other research approaches, our own study found that synaesthesia statistically predicted the number of exceptional experiences in a study that was exploring how personality, wearing a sham God helmet and time of day interacted with tendencies to report experiences (Simmonds-Moore, et al., 2019b).

Intriguingly, the systematic exploration of synaesthesia and psi has been fairly neglected in academic parapsychology, with only two studies that have explored it. In 1997, a study was undertaken among seven school children who were engaged in abacus training in Japan (Sako & Honmaz, 1997). The study was a clairvoyance design, which found support for the psi hypothesis. The authors noted that their previous studies with children had found evidence for sensory transfers between the mode of presentation of the target and the experienced response, indicative of fusions between sensory modalities in the context of psi. The authors describe evidence for synaesthetic processes at play in two successful clairvoyance trials and propose that synaesthesia may provide clues regarding the mechanism of clairvoyance. My own research explored precognition in a group of synaesthetes and matched controls but did not find a statistical difference between the groups. However, post hoc findings indicated that synaesthetic associators did better than projectors at the psi task (see Simmonds-Moore, 2022b).

Synaesthesia and creativity

There is a clear association between synaesthesia and creativity. First, many people who are creative are also synaesthetes, including various famous creators from history such as Kandinsky, Klee, Nobokov and in

contemporary times, Lady Gaga, Pharrell Williams, Billie Eilish and her brother Finneas (among others). One author has argued that Nobokov may have actually sought to elicit synaesthetic type experiences among his readers (Dureau, 2019). It is also the case that synaesthetic ideas have been employed by music educators to facilitate learning and creativity (Guarriello, 2023).

From a neurological perspective, a recent case study found that a traumatic brain injury (TBI) resulted in increased creativity and emergent synaesthesia in a person who was already working as a musician. This was associated with several novel compositions, in addition to the development of perfect pitch and sound to colour synaesthesia that lasted 4 months after the TBI (see Abou-Khalil & Acosta, 2023).

Research supports a general association between creativity and synaesthesia. Synaesthetes have sometimes been found to score higher on several measures of creativity (Chun & Hupé, 2016), although this literature is mixed in terms of measures of creativity (see Lunke & Meier, 2018). Echoing the observations regarding the relationship between creativity and psi, there seems to be a stronger association between synaesthesia and those working in creative professions than scoring on measures of creativity. For example, a recent article by Lunke and Meier (2018) found a higher prevalence of artists among those who are synaesthetes, particularly those who are sound-colour synaesthetes. Those who were sequence colour synaesthetes showed a higher involvement in visual art. Scoring on measures for divergent creativity were higher among grapheme-colour and sound-colour synaesthetes, and synaesthetes generally tended to be better at visuo-spatial abilities as measured by scoring on a mental rotation task. This was particularly the case among those exhibiting multiple types of synaesthesia. Intriguingly, visuo-spatial abilities seemed to be particularly important for divergent creativity (among synaesthetes and non-synaesthetes). A later study (Lunke & Meier, 2022) further explored the associations between synaesthesia and art and found that synaesthetes tend to be more interested, more active and rated as higher performing in their artistic practices.

Banissy et al. (2013) proposed that synaesthesia is linked to a broader (individual difference) phenotype that includes tendencies toward a range of anomalous experiences, alongside stronger mental

imagery and creativity. More recently, Ward (2019; Ward & Filiz, 2020) has discussed evidence for what he refers to as a *synaesthetic disposition* among those who do not display the phenomenological characteristics of synaesthesia. These individuals display other sensory and perceptual features that are relevant to researchers interested in psychic experiences and creativity. These features are listed as including enhancements of sensory processing, memory, creativity, vivid mental imagery, and better attention-to-detail. This phenotype would reflect the traits associated with individual difference measures that also correlate with creativity, psi and psi experiences. Banissy et al. (2012) previously found a link between synaesthesia and positive schizotypy. In turn, positive schizotypy correlates strongly with transliminality (Thalbourne & Maltby, 2008). Transliminality is a variable that incorporates creative cognition at its core, and is defined by its association with neuroplasticity, tendencies to make connections at various levels within the perceptual and cognitive system and be able to fuse aspects of experience into imagistic forms via enhanced syncretic thinking (Lange et al., 2019). Those exhibiting phenomenological synaesthesia or who score higher on indices of a higher synesthetic disposition may exhibit traits that can help us to better understand psi, psi phenomena and creativity. In the next section, I examine these common correlates in more detail.

Unpacking some common correlates

Qualitative research (Simmonds-Moore, 2016) supported a role for synaesthesia in *enabling* psi experiences and other exceptional abilities (e.g., memory, mathematics, musical improvisation). This research was part of a prior Bial-funded study and suggests several aspects of synaesthetic experiences that I will discuss in the following sections. These include the observation that Harry had strong associations between various aspects of the world and colours. This resulted in a very organized hierarchy of information which consisted of specific colours that corresponded to particular information. For example, in the context of music, there were colours for musical notes, for songs, and for genres of songs. Harry also had a similar hierarchy of colour-coded information for time (specific days and months of the year, in particular). These specific representations

could be accessed in terms of their meaning and manipulated in the context of creativity (for Harry, musical improvisation). There was also evidence of an ability to control these synaesthetic experiences based on attention and other strategies. Metacognition is discussed as important for creativity and psi experiences in the last section of this paper.

These tendencies are underpinned by a different nervous system that contributes to creativity and psi experiences. It is not possible for humans to detect and perceive all information, but we will discuss how synaesthetic nervous systems are wired differently. We will particularly discuss the idea of an *optimized sensory processing system* (Ward, 2019) that is associated with synaesthesia and those who share common traits in the population (the synaesthetic disposition). This type of nervous system may allow for the detection and perception of more information than others. In addition, the features of this type of nervous system may also enable the processing, representation of, and access to usually "unseen" stimuli (deriving from internal, external and potentially non-local sources) (see Simmonds-Moore, 2022b). Such features include exhibiting enhanced sensitivity, a hyperconnected nervous system (that also translates to tendencies to connect information at other levels in the cognitive hierarchy), stronger and more vivid mental imagery (representations), and access to meanings and signifiers that are concrete and more available to consciousness. Metacognitive abilities will also be discussed in terms of being able to reflect on and control experiences (via attention and other features) and to have access to the meanings signified by representations, which may lead to creative insights and insights that seem psychic or may actually reflect access to information that is distant in space and time.

Sensitivity

One of the core features of synaesthesia (and those exhibiting the synaesthetic disposition) is that they have *optimized sensory processing* (Ward, 2019). Ward notes that this can contribute several cognitive and other benefits. There are various measures for sensitivity, but in general, sensory processing sensitivity can be defined as a neurobiological trait that reflects "a genetically determined trait involving a deeper (in the sense of Craik & Lockhart, 1972) cognitive processing of stimuli that is

driven by higher emotional reactivity" (Aron et al., 2012, p. 262).

Sensory processing sensitivity has been empirically associated with psi experiences (Williams et al, 2022), ASMR (Poerio et al., 2022b), Synaesthesia (Ward et al., 2017; Ward et al., 2021) and creativity (Bridges & Schendan, 2019). In terms of psi experiences, Jawer (2006) found that several types of neurobiological sensitivity played an important role in a range of psi experiences. In terms of ostensible psi, ongoing research by Roxburgh, Schofield and Vernon is exploring how sensitivity relates to psi, and finding some interesting results (e.g., Vernon et al., 2023).

In terms of synaesthesia, synaesthetes appear to demonstrate indices of enhanced sensitivity outside of the context of their concurrent experiences, across several neural signatures in the brain (Ward et al., 2021). In addition, this was independent from scoring on measures of sensory sensitivity and seems to be a neurological index of synaesthesia. The authors suggest that these findings suggest that "visual regions that are normally later in the hierarchy have an unusually high responsiveness to simple visual features" (*p.* 261). It is also the case that the number of clusters within any given synaesthete is associated with a higher level of sensory sensitivity (Ward et al., 2022).

Sensitivity is also a core component of transliminality, which incorporates *hyperaesthesia* (an enhanced sensitivity to sounds, lights, etc.) alongside creativity and tendencies toward psi experiences (Lange et al., 2019). Research has found that transliminal people have lower vibrotactile thresholds, greater sensitivity to subliminal perceptions and bodily sensations and physiological changes (*cf.* Lange et al., 2019). It is also noteworthy that there was an increase in sensitivity in the TBI case discussed earlier in terms of acquired synaesthesia and enhanced creativity, supporting sensitivity as an important contributing variable for both (Abou-Khalil & Acosta, 2023).

In terms of lending insights into creativity and psi experiences, a higher level of sensitivity might enable more information to register in the cognitive-perceptual system in the first place, including information from various sources (internal and external). This could facilitate creativity due to an optimized ability toward perceiving more information in the system, which would provide the ingredients for creative processes (described earlier). Sensitivity could also facilitate psi experiences and

better performance at psi tasks as sensitivity might allow for the detection/perception of various forms of subtle information that may sometimes include non-local information.

Connections

Tendencies to form connections permeate systems that are associated with synaesthesia, creativity, and with greater likelihood of reporting psi experiences and beliefs. Synaesthesia is generally understood to be associated with increased neural hyperconnectivity (Mitchell, 2013; Rouw, 2013; van Leeuwen, et al., 2015). This may work differently according to the type of synaesthesia (Arias & Saint-Amour, 2019; van Leeuwen, et al., 2015). Mroczko-Wąsowicz and Werning (2012) have proposed that synaesthesias may emerge from hyper binding processes that work across the brain to fuse different attributes together across different cortical regions. These tendencies to connect relate particularly to networks of connection related to synaesthetic concurrent experiences (e.g. colours) (Ward et al., 2022). This suggests that where synaesthesia interplays with creativity and psychic experiences the resulting experiences might manifest in a specific ways. For example, musicians might directly represent their synaesthetic experiences (e.g., colours for sounds) as music; artists might represent their experiences (e.g., colours for emotions) as colours (in visual art) or physical forms (in sculpture), and psychics might interpret certain experienced shapes, images or colours as signifying certain types of information (from various forms of synaesthesia, e.g., colours for personalities or emotions, etc.).

Similarly, and in alignment with its possible candidacy as a trait pertaining to the *synaesthetic potential*, transliminality is defined by its tendencies toward neuroplasticity at various levels within the system (Lange et al., 2019). Marwaha and May have proposed that cognitive hyperconnectivity is important for their model of psi (Marwaha & May, 2015). Here, the hyperconnective aspects of the synaesthetic nervous system (in particular) are implicated in the processing of a nonlocal stimulus and drawing it into the cognitive realm. There is also evidence for wider neural connectivity and greater activation of semantic networks (associational thinking) in creativity (Kenett et al., 2014), synaesthesia (Goodhew et al., 2015; van Leewen et al., 2015), and in those prone to

psi experiences and paranormal beliefs (Farias et al., 2005). In terms of creativity, this aligns the proposal that prior to with creativity as resulting from tendencies to connect semantic information into innovative combinations (see Lubart & Thornhill-Miller, 2020).

Cognitive tendencies to form meaningful connections also translates to apophenia, which is the experience of perceiving meaningful shapes in random backdrops. This plays a role in both creativity and psi experiences (Rominger et al., 2022) and has been explored in the context of psi performance (Simmonds-Moore, 2014). The link between this tendency to perceive meaning in random backdrops and psi experiences can also be noted in other examples of scrying[9], including mirror gazing in the psychomanteum (Caputo et al., 2021).

Accessing unconscious information and the synaesthetic potential

There is evidence for greater influence of information that is usually outside of consciousness or *at the edges of attention* in creativity, transliminality, synaesthesia, psi experiences and psi. Synaesthetes are more likely to report lucid dreaming (the experience of achieving conscious awareness of dreaming while still asleep; Voss et al., 2007, p. 1191) than non-synaesthetes, suggesting greater conscious access to information that is often outside of conscious awareness. Research has found that synaesthetes demonstrate enhanced perception and attention, in the context of better performance on tests of embedded figures (Burghoorn et al., 2019; Ward et al., 2018) and in change blindness (Ward et al., 2018). This suggests that more information might be available to the cognitive system among synaesthetes.

There is a clear role for attentional processes in synesthetic experiences such that the inducer seems to need to be attended to in order to elicit the subjective experience of the concurrent (Rich & Mattingley, 2013). There is also a lot of evidence that the inducer should be consciously perceived (Arias & Saint-Amour, 2021). However, one study found evidence that synaesthesia could be elicited without conscious awareness (Smilek et al., 2001) and another found evidence for preattentive

[9] Using shiny surfaces (water or mirrors) or random backdrops (e.g., reading the tea leaves) to divine the future, or connect with ancestors or deceased loved ones.

processes in synaesthesia (Jäncke et al., 2012). A neutral way to approach this body of research is that there needs to be *some* access to the concept (or representation) to elicit phenomenological synaesthetic experiences (Chou & Rich, 2014). I discuss the role of stronger and more vivid representations in synaesthesia in a later section of this paper.

Creativity has been linked to drawing from different states of consciousness for creative products (Rebecchi & Hagège, 2022). For example, in their model of creativity, Girn et al. (2020) propose that creativity involves a dynamic movement between the generation of creative ideas in an unconstrained manner (or creative generation, akin to divergent thinking) in addition to processes of evaluation or constraint in which the products of the unconstrained thinking are more consciously considered (Girn et al., 2020). This seems to reflect a movement between different modes of thinking and states of consciousness. Likewise, transliminality reflects fluid shifts into different states of consciousness (Fleck et al., 2008) and more unconscious influences on consciousness in general (Lange et al., 2019).

In terms of psi, our research project using a latent inhibition paradigm found evidence that psi is filtered out of attention in similar ways to the unattended stimulus (Holt et al., 2020). Similarly, and as noted earlier, there is general evidence that psi is better measured by implicit (Palmer, 2015) and psychophysiological indices (Radin & Pierce, 2015). It is also the case that performance at psi tasks generally tends to correlate with a range of altered states of consciousness (Cardeña, 2020). These patterns all suggest that information registers in the system but does not reach conscious awareness in all individuals, appearing instead in behaviors, mood and actions as articulated by Carpenter's First Sight Model (e.g., 2004).

We can consider the Entropic Brain Hypothesis (EBH) (this is the 1st time we see this – Carhart-Harris, 2018) alongside Carpenter's model, and note that if psi phenomena are preconscious, then this information may be present in the context of entropic states of consciousness that we might dip into and out of. The EBH argues that we are usually in a state of slight subcriticality, but in altered states, we enter entropic states that are associated with primary process thinking. Too much emergence into primary processes might swamp conscious awareness (and according to EBH, eliminate awareness at some level) (Carhart-Harris, 2018).

Consciousness is assumed to emerge where there is a balance between order and disorder - i.e., a critical region that allows for subjectivity. In the waking state, we would be less likely to notice information in our unconscious mind, but this information might be visible in implicit forms, in alignment with psychoanalytic theory and for psi, the First Sight Model (Carpenter, 2004). Some people may be better able to move dynamically between these areas of the mind and be able to efficiently bring subtle and usually unconscious information into awareness.

Fractal structures have also been observed in brain signatures associated with the emergence of consciousness in the liminal area between chaos and order (*cf.* Varley et al., 2020b). I have recently argued that fractals are a good lens for psi, given the liminal nature of psi phenomena (Simmonds-Moore, 2023). In support of this, fractal signatures are also more visible in states of consciousness that have been connected to psi performance – in particular, REM sleep (Varley et al., 2020b) and meditation (Walter & Hinterberger, 2022). In addition, another study found support for the existence of fractal structures in the context of psychedelic states (LSD and psilocybin) (Varley et al., 2020b), which are often associated with subjective psi experiences.

In addition, fractal signatures are also connected to creativity (Forsythe et al., 2011; Robles et al., 2021; Taylor et al., 2011) and there is a heightened tendency to prefer fractals among those who are more creative (Pepin et al., 2022). In addition, one study found a memory advantage for fractals among grapheme-phoneme synaesthetes (Ward et al., 2013).

We can understand these patterns in the context of the idea of Ward's notion of the synaesthetic disposition and our notion of the synaesthetic potential (Simmonds-Moore et al., 2019a). This proposes that people with a synaesthetic disposition in terms of their traits (i.e., transliminality and related variables) will be more likely to experience synaesthesia in the context of altered states and via learning compared to others, which equates to a *potential* for synaesthetic experience. This draws from observations that synaesthetic experiences can emerge transiently in some individuals in the context of a range of altered states of consciousness among those who are not synaesthetes in the waking state, discussed earlier (Cardeña, 2005; Luke & Terhune, 2013; Nair & Brang, 2019; Walsh, 2005). It is also supported by the observation that those who

are already synaesthetes, can experience different synaesthesias in altered states, including psychedelic states (Luke et al., 2022). We have also proposed that synaesthesia might be more efficiently learned among those showing traits suggestive of the synaesthetic disposition, such that there is a greater potential for synaesthesia to emerge under certain circumstances (Simmonds-Moore et al., 2019a).

In summary, information that is usually outside of conscious awareness, including psi information, is more available to consciousness in some altered states. In addition, some people have more access to information that is usually outside of consciousness (in the waking state) by moving in dynamic ways between different states. This may occur via greater access to liminal states and movement across the thresholds between criticality and subcriticality where fractal structures are richer and subjective experience (consciousness) is more likely. There may also be more efficient processing (and filtering) of subtle information via different attentional and sensory systems. Synaesthesia and emergent synaesthesias (in those with a synaesthetic potential) may also contribute to creativity and psi via more concrete concurrent representations (described in the following section).

Representations

Synaesthesia and synaesthetic experiences (including those that are transient in the context of altered states) may play a role in the conscious access to unusual ideas, weak stimuli, and for nonlocal information and in turn play a role in creativity and psi experiences. I suggest that this occurs via tendencies toward stronger mental imagery and representations.

Vividness of mental imagery has been associated with psi experiences (Hume & Lawrence, 2005) and with synaesthesia (Price, 2013; Spiller et al., 2015). There is also evidence for stronger representations in synaesthesia (Terhune et al., 2013) which could also relate to the enhancement of memory that is often associated with synaesthesia (Ward et al., 2019). Transliminality is strongly associated with tendencies to form syncretic connections between aspects of the experiential world, including synaesthesia, physiognomic imagery and eidetic imagery (Lange et al., 2019).

In terms of creativity, research has found that measures of divergent

creativity related to an enhanced ability to mentally rotate imagery. This pattern was found overall, but was also connected to synaesthesia, particularly when people exhibited multiple forms of synaesthesia (Lunke & Meier, 2018).

Thus, those with synaesthetic tendencies might be understood to be more likely to experience concrete/tangible representations for a range of stimuli (from the unconscious, and aspects of the physical and social world) that might otherwise be outside of awareness. This can be understood in the context of synaesthetic inducers and concurrents, in which synaesthetic concurrent experiences provide concrete or accessible representations as labels or "codes" for specific inducing stimuli, facilitated by having stronger or more vivid qualia. This might include inducers that fall at the edges of conscious awareness, but which are experienced tangibly via concrete concurrent experiences. As an example, Steve Parsons ran a study in the Albert Dock in Liverpool where he played infrasound to a medium, who perceived the infrasound as shadows that he subjectively equated with his usual experiences of "spirits" (Parsons, 2012). In addition, we found that there was an association between the earth's GMF and subjective experiences relating to a spatial presence *among synaesthetes only* in a psychomanteum study. In addition, we found that these experiences also correlated with the output of an RNG among synaesthetes only (Simmonds-Moore et al., ND). These patterns suggest that subtle information may be experienced concretely as subjective psi experiences, under some circumstances. In this case, the concreate experience also correlated with RNG anomalies, which should be explored more fully in future studies.

Metacognition, attention and health

Metacognition refers to an individual's capacity to "monitor one's own decisions and representations, their accuracy and uncertainty" (Deroy et al., 2016) and allows a person to essentially appreciate the products of their cognitions. This has not been systematically studied in the context of psi but has been implicitly studied by exploring those who are healthy and less healthy in terms of their psychic experiences.

Metacognitive factors appear to play a role in psi, creativity and synaesthesia such that there are different *ways* in which one experiences

the additional information and experiences available to them. For some, having more information available in the system due to looser attention, greater sensitivity, etc., may be overwhelming and stressful. For others, experiences seem to be accessed and experienced in a more controlled manner via an ability to control access to unconscious areas of the mind, and successfully move between different modes of thinking. In addition, in the latter context, experiences may be found to be more pleasant and may be applied (i.e., there is a social context for experiences that are healthier). This is also something that has previously been seen in the context of mediumship, whereby mediums develop metacognitive strategies (and healthier relationships with their experiences) *over time* (e.g., Roxburgh & Roe, 2014).

There is shared variance between each variable (creativity, psi, and synaesthesia), distress and health (akin to a Venn diagram). The association between creativity and mental health is nuanced, but seems to rest on how creativity is operationalized. For example, "when creativity is conceptualized or operationalized as dispositional, the association is negative, whereas it is positive when creativity is treated as a strategy (e.g., as an intervention method or regulation activity)" (Zhao et al., 2022). The association with strategy and health may also relate to the association between creativity (as a process) and the expression of emotions (*cf.* Lubart & Thornhill-Miller, 2020).

Creativity is associated with a dynamic movement between different modes of cognition and states of consciousness, such that one can effectively interact with unconscious ways of thinking or dip into less focused or loose attentional ways of being and move back into more focused modes of thinking in a controlled manner (Girn et al., 2020). This movement is echoed in Nicola Holt's (2007) notion of *epistemological flexibility* discussed in the context of creativity, psychic knowing and access to altered states of consciousness. It helps researchers to make sense of the observation that different types of attention interplay with different states of consciousness and different modes of attention and thinking styles play roles in different types of creativity (Rebecchi, & Hagège, 2022). This can also help us to make sense of the observation that there are mixed findings in the literature for the relationships between creativity and performance at attention-based tasks (*cf.* Holt et al., 2020) and psi

tasks (Holt, 2013).

The direct relationship between psi and mental health itself is understudied and has mixed findings overall. A recent study explored performance at a task designed to test precognition in a group of healthy participants and in a group with psychosis (Escola-Gascon et al., 2022). Here, precognition was stronger in the clinical group, but this might be explained by other factors, including the idea of a trait that relates to *both* health and poorer health (see discussion on schizotypy below).

In terms of synaesthesia, our study found no direct association between synaesthesia and wellbeing (Simmonds-Moore et al., 2019). In contrast, another study found that there is shared variance between grapheme-colour synaesthesia and anxiety disorders (Carmichael et al., 2018). The relationship with anxiety may well relate to the idea that synaesthesia emerges from diverse aetiologies, some of which include propensities toward mental health issues (*cf.* Ward, 2021). Another way to explore this is in terms of traits associated with the synaesthetic disposition, and how synaesthesia relates to other factors.

Shared variance with the schizotypy variable

One way to unpack these relationships is in the context of their shared variance with the multidimensional personality construct of schizotypy. Schizotypy has been described as "a personality trait that interacts with risk for psychosis and schizophrenia" (Alminhana et al., 2017, *p.*126) but which is neutral in terms of mental health. There is a growing body of research that indicates that metacognitive factors, an organized cognitive architecture and social and cultural factors interact with scoring on measures of positive schizotypy which is most aligned with psi experiences and which I previously noted correlates strongly with Transliminality (Thalbourne & Maltby, 2008) and may be a trait that aligns with the synaesthetic disposition.

Schizotypy is a multifactorial construct that includes four different factors including: (1) *positive schizotypy or unusual experiences*; (2) *disorganized schizotypy*, reflective of cognitive disorganization and attentional difficulties; (3) *introverted anhedonia*, reflective of emotional flatness; and (4) *impulsive nonconformity*, reflective of manic and impulsive tendencies. There are four main ways in which people tend

to score on the schizotypy scales, which essentially reflects different ways in which one experiences unusual experiences. The groups are generally considered to reflect *healthy schizotypy* (high scoring on positive schizotypy but lower scoring on other measures); *low schizotypy* (low scoring on all measures); *high schizotypy* (high scoring on all measures, but in particular cognitive disorganization and introvertive anhedonia) and *negative schizotypy* (high scoring on only introvertive anhedonia). Those who fit the healthy schizotypy profile are characterized by high levels of wellbeing and flexible/fluid thought processes (Mohr & Claridge, 2015). In addition, there seem to be different paths to experiences between the healthy and high schizotypy groups. Those who are healthy schizotypes tend to experience psi and other unusual experiences in relaxing states via "controlled disinhibition of brain systems" (Grant & Hennig, 2020). The less healthy profile is associated with experiences emerging in the context of stress (Grant & Hennig, 2020). Schofield and Claridge (2007) found that an adaptive and explanatory framework associated with cognitive organization rather than disorganization works to provide a schema for experiences which might otherwise seem strange and intrusive and allows them to be appraised positively and under the control of the experiencer (aligned with good metacognition). Research supports a strong interaction between social and cultural factors for phenomena such as voice hearing (*cf.* Lurhman et al., 2015) and mediumship (*cf.* Roxburgh & Roe, 2015).

Various measures of creativity correlate positively with positive schizotypy, negatively with negative schizotypy, but they do not tend to relate to cognitive disorganization (see Holt, 2015). In general, there seems to be good evidence overall for an association between creativity and the healthy profile of schizotypy (Holt, 2019; Nettle, 2006).

In terms of psi, our research found some support for more efficient filtering of a psi stimulus in the context of an attention-based psi task among those with a healthier profile of schizotypy (Holt et al., 2020). This suggests that healthier individuals are better at ignoring psi stimulus when they are not relevant to the current task. The mixed findings in terms of mental health and psi could be explained by the synaesthetic disposition which may reflect traits aligned with schizotypy, including transliminality, which has also been associated with extrasensory perception (Houran, & Lange, 2009).

In terms of synaesthesia, Carmichael et al. (2018) also noted that the relationship with anxiety may partially be explained by the shared variance between synaesthesia and the schizotypy construct (*cf.* Carmichael et al. 2018). Banissy et al. (2012) found that grapheme-colour synaesthetes scored higher on positive and disorganized forms of schizotypy but synaesthetes did not score higher on the negative or impulsive forms of schizotypy. This suggests an association with the less healthy schizotypy profile. However, our own research found that people exhibiting the healthy profile of schizotypy scored higher on our measure of synaesthesia (Simmonds-Moore et al., 2019a). In alignment with a healthy and less healthy profile, our study included many individuals with an interest in psi experiences, and who reported psi experiences themselves. This indicates that the relationship with wellbeing differs according to *how one interacts with and applies their experiences*. These relationships may differ according to the type of synaesthesia and the way in which concurrents are experienced.

One recent study (Mas-Casadesus & Gherri, 2017) found evidence that synaesthetes were more efficient with their attentional processes and were less distracted by irrelevant stimuli (particularly when conflicting information correlated with their concurrent experience). This aligns with the results of our latent inhibition study where irrelevant psi stimuli were more efficiently filtered out of attention (Holt et al., 2020). In conjunction with a role for metacognition in the context of creative strategies, we might conclude that those are able to control access to and apply their anomalous and synaesthetic experiences in creative contexts or as psychic practitioners will be more psychologically healthy. This might also translate to better creative outputs and doing better at psi tasks among synaesthetes and those with traits indicative of the synaesthetic disposition (who fit the healthy profile). Among these folk, good metacognitive skills also involve greater efficiency in ignoring irrelevant information, but the information is in the system and potentially available for application.

Conclusions: A complex recipe

Among those who exhibit the synesthetic disposition, there seems to be an increased tendency for more information to register in the system

at the physiological level, due to an enhancement of neurobiological sensitivity and more efficient attention among synaesthetes (and those expressing traits aligned with transliminality and related variables). Good metacognitive abilities that are associated with creativity and the healthy schizotypy profile allow for flexible thinking and the ability to move between modes of thinking and states of consciousness. Dynamic movement between the unconscious and conscious areas of the mind, alongside wider attention may lead to more awareness of information that is usually outside of conscious awareness. The enhanced tendencies toward making connections (at different levels in the cognitive-perceptual system) may function to fuse or bind information into an interconnected, vivid and concrete form via enhanced syncretic processes. In turn, these representations are stronger and more vividly experienced. The stronger representations may then be more amenable to cognitive manipulation, including mental rotation that underpins divergent thinking. There would also be a greater likelihood of being able to tangibly perceive representations and their associations in novel ways. In addition, imagery would be more consciously available, such that meanings may be accessed and connections can be made with the wider cognitive architecture *and within the social context*. This could lead to creative insights and/or awareness of information that is usually distant in terms of space and time. As such, focusing on those with synaesthesia and traits indicative of a synaesthetic disposition (and synaesthetic potential in the context of altered states of consciousness) will be valuable for understanding differences between those who do well at psi tasks and those who do not, and those who are successful in their creative endeavours.

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BREAKING BARRIERS: EMERGING TOPICS IN CREATIVITY AND INSIGHT RESEARCH

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Abstract

Insightful ideas are a powerful expression of creativity. Hundred years after Wolfgang Köhler observed "insightful" behaviour of chimpanzees on the island of Tenerife, creative problem solving has become an exciting area of research, with links to metacognition, memory and emotion. New methodological approaches have revived the field. Research addressing the peculiar phenomenology of insight ("Aha! experiences") on the level of the individual person has seen the most interest recently, but the crucial question of how new ideas emerge still remains to be answered. This chapter gives an overview on contemporary efforts to understand human problem solving and creativity. Topics to be discussed are the role of insight in creative problem solving, including affective and cognitive components, mental set and fixation, benefits of insight, and strategies to overcome fixation.

1. Introduction

The perennial question of how humans generate new ideas remains highly relevant today. This chapter explores emerging topics that are addressed in contemporary investigations of insight and creativity: Affective and cognitive components of creative problem solving, mental set and fixation, benefits of insight, and strategies to overcome fixation.

The origins of insight and creativity research trace back to the 1920s of the last century, when German Gestalt Psychologists like Wolfgang Köhler, Max Wertheimer, Karl Duncker, and Kurt Koffka embarked on empirical explorations of human problem solving behaviour. From

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1912 to 1920, during his time at the Anthropoid station ("La Costa") of the Prussian Academy of Sciences on the island of Tenerife, Köhler conducted groundbreaking research on animal cognition. He studied a group of chimpanzees that had been brought to the island for research purposes, since there are no naturally occurring ape populations on Tenerife. His observations on the "mentality of apes" were published as a book (Köhler, 1921). One notable experiment involved a chimpanzee faced with the challenge of retrieving a banana hung high up in the cage, surrounded by scattered boxes. After several unsuccessful attempts at reaching the banana by jumping, the chimpanzee paused, seemingly reconsidering the situation. Suddenly, the animal began stacking the boxes, climbed atop the stack, and retrieved the banana. Köhler argued that this sequence of behaviour could not be attributed to simple stimulus-response associations proposed by behaviorists like Watson (1913). It did not align with the ape's prior experience nor was it achieved through trial and error. Instead, Köhler proposed that the ape acted insightfully.

But what does it mean to act "insightfully"? The general idea is that insights represent a mental leap: Sometimes, after a phase of deliberation, solutions to difficult problems simply pop into mind, seemingly out of nowhere. Insights are fundamental for innovation and creativity, and for advancing our understanding of the world. Examples are spontaneous discoveries of laws of nature, generation of novel ideas or sudden insight into the function of an initially inscrutable system. Various definitions of insight have been proposed, for example: "Insightful solution processes represent cases of problem solving that involve an abrupt shift from a state of bewilderment or confusion to a state of clarity and understanding, in which a new interpretation emerges that enables everything to fit together." (Wiley & Danek, 2024, p. 43) or "Specifically, we define insight as any sudden comprehension, realization, or problem solution that involves a reorganization of the elements of a person's mental representation of a stimulus, situation, or event to yield a nonobvious or nondominant interpretation." (Kounios & Beeman, 2014, p. 74). Note that in both cases, the underlying cognitive mechanism is postulated to represent a sudden restructuring of knowledge (Ohlsson, 1984, 1992). At least some parts of the insightful solution process occur at the unconscious level, making it difficult to articulate the steps leading to solution, which

gives rise to the impression that the solution emerged suddenly, out of the blue. In general, this is a rather pleasurable surprise: "The happiest inconsistency between intention and action occurs when a great idea pops into mind. The "action" in this case is the occurrence of the idea, and our tendency to say "Eureka!" or "Aha!" is our usual acknowledgement that this particular insight was not something we were planning in advance. Although most of us are quite willing to take credit for our good ideas, it is still true that we do not experience them as voluntary." (Wegner, 2002, pp. 81-82).

As described by Wegner, the sudden emergence of a solution is typically accompanied by a special feeling state, the so-called "Aha! experience". Those delightful moments, famously epitomized by Archimedes' exclamation of "Eureka!" when he jumped out of the bath after discovering the law of buoyancy (Vitruvius Pollio, 1914, p. 254), are familiar to everyone. The Aha! experience is not a unitary construct, but rather a bundle of different emotions, among them pleasure, relief and surprise. A comprehensive review of the current literature, including studies that empirically investigated the phenomenology of Aha! experiences, came to the conclusion that the three key components of Aha! were pleasure, confidence and subjective suddenness (Danek, 2024). This yields an empirically-based definition of Aha! experiences as "a multifaceted, subjective reaction to gaining a deeper understanding that includes affective (pleasure) as well as metacognitive dimensions (confidence, subjective suddenness in the emergence of a solution)" (Danek, 2024, p. 315).

In general, insight can be conceptualized as a phenomenon that comprises two distinct components, a cognitive (restructuring) and an affective one (Aha! experience). Restructuring often occurs after a period of incubation and involves a fundamental shift in how individuals perceive and represent a problem. When faced with a challenging task, solvers may initially approach it from an incorrect perspective, often leading to a state of impasse or feeling stuck (Ohlsson, 1984). From that perspective, the problem appears unsolvable. Restructuring the mental representation of the problem may involve breaking down the problem into smaller, more manageable components, recombining existing elements in novel ways or relaxing constraints (Knoblich et al., 1999). Ultimately, restructuring

enables individuals to break free from the impasse and explore alternative pathways to a solution. On the other hand, the affective component represents the subjective solution experience that accompanies insightful solutions. Feelings of Aha! are generally positive and marked by pleasure, confidence and subjective suddenness (Danek, 2024). Together, these two components of insight - restructuring and the Aha! experience - constitute a dynamic and multifaceted process that drives creative problem solving. Understanding the interplay between these two components will provide valuable insights into the mechanisms underlying creativity and its role in human cognition.

2. Tasks to study insight

A key methodological challenge is how to capture the elusive phenomenon of sudden insight in a controlled laboratory setting. This requires problems that appear unsolvable at first glance, where the initial strategies typically fail, and where individuals experience fixation. The field has meanwhile moved away from the idiosyncratic, single-trial problems introduced by the Gestalt psychologists (e.g., the candle problem, Duncker, 1935; or the Nine Dot Problem, Maier, 1930) to sets of similar but unique problems, in order to increase statistical power. Those problem sets include, for example, Matchstick Arithmetic Problems (Knoblich et al., 1999), the Compound Remote Associates Task (Jung-Beeman et al., 2004) and Mooney Pictures (Imamoglu et al., 2012; Mooney, 1957). As an alternative which is perhaps closer to real-world problem solving, I have developed the magic trick paradigm. This problem set consists of 35 video clips of magic effects, performed by a professional magician (Thomas Fraps, see Abbott, 2005). Magic tricks are presented as problem solving tasks, asking participants to figure out how the magic effect is achieved. Discovering the hidden principle of a trick elicits strong Aha! experiences (Danek et al., 2014a). Like classical insight problems, magic tricks require a restructuring of the problem representation by relaxing prior assumptions, e.g., about object properties such as weight or size (Danek et al., 2014b). This and the other problem sets are widely used in a new wave of research aimed at elucidating the affective component of insight.

3. Benefits of insight

In addition to the well-documented feelings of pleasure associated with insights (Thagard & Stewart, 2011; Topolinski & Reber, 2010), increasing evidence points towards further benefits of insight. It seems likely that insight has an adaptive function: Solutions accompanied by Aha! experiences are not only more likely to be correct than those without ('accuracy effect', Danek et al., 2014b; Salvi et al., 2016), but they are also better remembered, even after delays of up to two weeks (Danek et al., 2013; Kizilirmak, Galvao Gomes da Silva, et al., 2016). Positive emotions, akin to the memory enhancement observed with emotional stimuli (Talmi, 2013), may underlie this "insight memory advantage" (Danek & Wiley, 2020). In the following section, we will consider these two specific benefits in more detail.

3.1. Accuracy effect of insight

In their quest for knowledge, humans tend to rely on their insights as an indication of truth, because Aha! experiences often come along with a strong sense of being right. Recent studies have tested whether insights are in fact associated with correctness or not. The first study that systematically compared solutions with and without Aha! experiences, using problem solvers' self-reports, was conducted by Danek et al. (2014b). In that study, problem solvers were presented with a randomized series of 34 magic tricks, and had to find out the secret method behind each trick. Upon providing a solution, solvers were asked to indicate whether they had experienced an "Aha! moment" or not (binary rating) as well as how confident they were that their solution idea was correct. Importantly, no feedback on the actual correctness of the proposed solutions was provided. Solutions for which solvers reported feelings of Aha! were more likely to be correct, in comparison to solutions without Aha! experience. This relationship has been consistently found across task domains such as anagrams, compound remote associates task, rebus puzzles, magic tricks and even line drawings (Becker et al., 2021; Danek et al., 2014b, 2020; Danek & Wiley, 2020; Hedne et al., 2016; Ishikawa et al., 2019; Kizilirmak et al., 2021; Marsh et al., 2021; Rummel et al., 2021; Salvi et al., 2016; Spiridonov et al., 2021; Stuyck et al., 2022;

Webb et al., 2016, 2018, 2019), with one recent exception (Stuyck et al., 2021). Moreover, solvers were more confident that their Aha! solutions were correct, in comparison to solutions without Aha! experience (mean confidence ratings of 84.6% compared to 63.1%). Therefore, it seems justified to state that humans possess an intuitive sense of success, and that in most cases, we can rely on our insights as being correct. Possible explanations for this key finding are discussed elsewhere (Danek & Salvi, 2020; Webb et al., 2021).

However, the accuracy effect should not be taken as indication that feelings of Aha! are infallible. It is crucial to acknowledge the existence of instances where strong Aha! experiences accompany incorrect solutions. Such "false insights" have been postulated theoretically (Ohlsson, 1984), and have now also been demonstrated empirically (Danek & Wiley, 2017).

3.2. Insight memory advantage

The idea that sudden insights during problem solving might promote memory for the found solution, or at least for the problem, has been part of the insight narrative for a long time (Dominowski & Buyer, 2000; Osgood, 1953; Scheerer, 1963). Ash et al. (2012) provide an account of insight learning as sudden, single-trial learning that occurs after solvers' initial solution attempts have repeatedly failed. Again, the process of restructuring the initial, inappropriate view of the problem is thought to enable a solution and subsequently increase its memorability. But it also seems possible that the Aha! experience, due to its strong emotional component, directly boosts memory. Initial evidence for this came from a study using the magic trick paradigm described above which involved subjective ratings of Aha! experiences after a solution was generated (Danek et al., 2013). Two weeks later, participants underwent a memory test (cued recall) for those solutions. Results indicated that solutions accompanied by self-reported Aha! moments were better recalled compared to solutions without Aha! experiences. This finding was replicated in two other experiments (Danek & Wiley, 2020). A similar memory advantage was observed in a perceptual problem solving task with a one-week delay (Kizilirmak, Galvao Gomes da Silva, et al., 2016). One possible explanation for the finding that Aha! experiences

provide long-term memory benefits is the positive affect that is involved. It can be understood as an intrinsic reward that boosts learning. This explanation points to a possible involvement of the dopaminergic system in insight learning, as also suggested by Kizilirmak and Becker (in press), but still awaits empirical validation. The finding that feelings of pleasure in particular predict memory (Danek & Wiley, 2020) supports the dopamine hypothesis, together with evidence from neuroscientific studies linking insight problem solving to the dopaminergic system (Kizilirmak, Thuerich, et al., 2016; Oh et al., 2020; Tik et al., 2018). Boundary conditions and potential mechanisms of the insight memory advantage are discussed in a recent review (Danek & Wiley, in press).

This memory effect could be exploited in all kinds of educational settings, opening up an avenue for future research. The first step would be to identify conditions that foster the occurrence of Aha! experiences in real-life learning situations, e.g., at university or school.

Given the benefits associated with insights – bringing joy, indicating truth, and enhancing memory –, it seems essential to identify conditions that promote their occurrence, a question that has already garnered significant attention. The following section discusses approaches to answering this question.

4. Overcoming fixation

One key challenge is how to escape fixation and break free from unwarranted constraints. The basic idea is to reduce the activation of initial, incorrect responses – essentially, to forget the fixation (Smith, 1995). One possible strategy to achieve this is incubation, which involves stepping away from the problem and interrupting the conscious work on it. In general, incubation periods have been found to be beneficial for creative problem solving, as breaks allow for unconscious processing and the formation of new connections (Sio & Ormerod, 2009). As reported anecdotally, time away from the task, for example when in bed, in a bath or on a bus is actually helpful (Ovington et al., 2018), because such mundane activities allow the mind to wander and disengage from the problem at hand. However, it is still unclear why exactly incubation is effective – different underlying cognitive mechanisms have been proposed. One is

the selective forgetting hypothesis (Smith, 1995; Smith & Blankenship, 1991) which states that by temporarily setting aside the problem and engaging in unrelated activities, the irrelevant, fixating information can be deactivated, allowing a fresh view of the problem (Koppel & Storm, 2014). Yet in order to solve a problem, solvers not only have to forget the fixating information, but also come up with new solution approaches. The spreading activation hypothesis suggests that during incubation, activation spreads widely across the semantic network, facilitating the activation of previously ignored but relevant associations (Gilhooly et al., 2013; Smith & Blankenship, 1989). These partially activated elements can then combine or interact with external cues to produce new solution ideas.

Given that incubation periods facilitate creative problem solving, the question is whether it matters how the break is filled. One possibility is to simply switch between current tasks. In a series of highly comparable studies, it has been shown that task switching improves performance, enabling solvers to generate more alternative approaches (George & Wiley, 2019; Lu et al., 2017; Smith et al., 2017). Another study (Caravona & Macchi, 2023) directly compared different types of activities to be engaged in during the break and found that the most effective tasks were those that were low-demanding, regardless of their nature. Such tasks require some level of attentional focus, which serves to divert attention away from the problem, while still leaving resources available for the unconscious restructuring process. For example, engaging in low-demanding tasks like calculating one-digit sums or finding the differences in two nearly identical pictures during an 8-minute incubation period substantially increased solution rates in that study. In contrast, a break of the same duration, but not filled with any activity (no incubation task) was not as effective, probably because attention remained fixated on the problem. These findings principally align with the theory of unconscious work during incubation, as proposed by Dijksterhuis and Nordgren (2006) or Gilhooly et al. (2013), but see Smith and Beda (2023) for a critical standpoint.

5. Conclusion

In conclusion, the phenomenon of insight encompasses both cognitive and affective dimensions, with the joy of discovery serving as a driving force for learning. The recent shift in focus towards the affective Aha! experience, together with the implementation of new problem sets, has led to a considerable increase in studies tackling this elusive phenomenon and enabled the field to move forward. Benefits of insight have been demonstrated, from signaling correctness to enhancing memory. Effective strategies for overcoming fixation include task switching and incubation, which allow for the exploration of alternative problem solving approaches.

Finally, it is important to note that feelings of Aha! can occur in quite diverse contexts of human experience. For instance, individuals often experienc Aha! when resolving tip-of-the-tongue states, as demonstrated by Metcalfe et al. (2017), when elusive words eventually come to mind. Similarly, Aha! experiences might also arise when people comprehend a joke, with the punchline triggering a sudden understanding and amusement (Bianchi et al., 2022). Making analogical leaps, such as connecting seemingly unrelated concepts, also elicits Aha! moments (George & Wiley, 2018), revealing the power of metaphorical thinking. Moreover, it has been shown that understanding complex mathematical concepts can lead to feelings of Aha! (Barot et al., 2024; Liljedahl, 2005). Possibly, achieving a breakthrough in therapy could involve Aha! moments as well (Caspar & Berger, 2007), when clients suddenly see their situation in a new light, paving the way for transformative change. There is much to be learnt from the investigation of Aha! experiences, not only in the context of creativity and insight problem solving, but also as an ubiquitous phenomenon that occurs in a variety of contexts and awaits further empirical investigation.

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THE MYTHS AND TRUTHS OF THE CREATIVE MIND: A SNAPSHOT

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Abstract

Is the right hemisphere the seat of the creative brain? Do psychedelic drugs enhance creativity? Does mental illness accompany creativity? These are some of the many polemic questions about creativity that have long been of interest to researchers and the general public alike. In our attempt to understand how creative minds operate, we favor explanations that are eccentric. It is as though any explanation for creativity, this seemingly magical phenomenon, must itself bear some inherent peculiarities to be convincing. When these notions come to be widespread and held as fact by many, academics often present them as pure myths that need to be debunked. Nonetheless, despite all the pronouncements and evidence to the contrary, creativity "myths" tend to persist. The question is why? In this paper I explore dominant notions that abound about the creative brain and how they come about, and, in doing so, unravel their roots and their truths.

"The universe is made of stories, not of atoms." (Muriel Rukeyser)

"A tale, fictitious or otherwise, illuminates the truth." (Rumi)

To have a creative idea is to experience the creation of something that is novel and satisfying (Abraham, 2023). Although it is a subject of great fascination to scholars and the lay public, the phenomenon of human creativity is still largely steeped in mystery. We know surprisingly little about the 'hows' and 'whys' of this remarkable ability that each of us

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possesses to some degree as human beings. While the underpinnings of such abilities can be found in other animals, in no other species is creativity as remarkably expressed as in humans. For one, the manifestations of creativity vary greatly both within and across domains of human endeavor. This can be seen from even a simplified classification of creativity into three broad types based on output and domain: artistic, scientific, and social. A creative output in the sciences can take on widely varying forms, such as the uncovering of matter or principles that were previously unknown (e.g., Marie Curie's discovery of radium), the innovation of an existing product or a creation of a new one (e.g., the invention of the smart phone), and the proposal of an original theoretical paradigm (e.g., Darwin's theory of evolution).

While the outputs in the sciences range from the tangible (e.g., matter) to the intangible (e.g., theories), artistic creative products always involve the creation of artifacts, physical (e.g., a sculpture) or embodied (e.g., a dance choreography) (Abraham, 2022). There are as many domains and subdomains of artistic practice (ranging from the fine arts to the applied arts) as there are sensory modalities and combinations of those modalities. Far less well studied is creativity in the social sphere where the proposal of a new idea or the eliciting of a novel and satisfying insight, prompts changes in the thoughts, motivations, and behaviors of others. This effect can be limited to a single individual (e.g., such as during the therapeutic process between a psychotherapist and a client) or the larger collective (e.g., the principle of non-violent civil disobedience as espoused by Mahatma Gandhi during the struggle for freedom in India against the British empire).

Only in human beings is the expression of creativity so vividly varied across contexts and across levels of expertise (e.g., a child and a composer inventing a tune are both being creative when they do so, albeit at widely differing levels of magnitude) (Boden, 2004; Kaufman & Beghetto, 2009). Another remarkable feature of human creativity is that we can engage in creative endeavors to high levels of competency at any stage of our lives. We bear witness to a range of phenomenon, both ordinary and extraordinary (Bateson, 1999; Simonton, 1999), when to comes to creativity which span the rare occurrences of incredible creative genius manifesting in early childhood (e.g., Mozart) to the fruition of newly

learned practices to achieve significant levels of artistry even in old age (e.g., Grandma Moses).

When considering the creative mind, it is also important to differentiate internal and external frames of reference. The internal frame of reference reflects the perspective of the creator/explorer/maker on their own work whereas the external frame of reference reflects the perspective of the recipient/audience/field on that work. Internal and external frames of reference need not correspond with one another. For instance, a person may evaluate a particular work they have created to be highly creative, but there is no guarantee that others, i.e., the viewers who receive this work, will agree with that estimation. While a child may experience a fulfilling creative journey as she pens a novel story, a process which in some ways may be similar to that of an established author, that does not mean that readers who come by that story will deem that child's work to be particularly creative. So, it is vital to consider internal versus external frame of reference when examining the creative process (Stein, 1953).

A scholarly examination of the creative mind therefore runs into a unique problem. Trying to understand the creative mind of the creator/maker/explorer necessitates the assessment of the internal perspective. However, the internal perspective is often not even acknowledged in studies of the creative mind. In fact, the external perspective of the recipient (who typically takes the form of the judge or the rater of the creative product) is routinely taken as a proxy for the internal perspective of the creator. Much of what we know (or rather think we know) is true about the creative mind is largely based on the perspective of what someone else (recipient/audience/field) believes to be true, not the perspective of the person (creator/maker/explorer) whose mind is the subject of study (Abraham, 2023). What this means is that the stories we tell about the workings of the creative mind fundamentally stem from the third-person perspective of a recipient, rather than the first-person perspective of the creator.

In our attempts to understand how creative minds work, we are drawn towards stories and explanations that are outlandish in some way (Benedek et al., 2021). This can be consistently observed throughout recorded human history. It is almost as though any account that explains how a truly marvelous phenomenon like human creativity comes about

must feature some inherent eccentricities to be persuasive. Only dazzling explanations seem to suffice in adequately capturing how a person has created a work of art that deeply moved us. It is far more enchanting to learn that an idea for a brilliant invention came to a creator in a dream, rather than through continuous tinkering with a planned set of actions over a long period of time. Our proclivity to favor and accept exciting narratives can be attributed the fundamental human affinity for storytelling (and thereby story-listening) (Boyd, 2010, 2017). And in the case of the creative brain, there are several charming stories that are widespread - (1) that the site of creative brain is the right hemisphere; (2) that mental illness is associated with creativity; (3) that the intake of psychedelic drugs can boost one's creativity; (4) that an atypical brain is required for remarkable levels of creativity; (5) that creativity is linearly associated with intelligence; (6) that dopamine play a critical role in creativity; and (7) that the default mode network is the seat of creative ideation.

Many scholars have examined these popular stories that seek to explain the creative mind as "myths" that need to be debunked (Dietrich, 2014; Schlesinger, 2012; Weisberg, 1987). Nonetheless, despite such efforts which include the detailing of evidence to the contrary, creativity "myths" persist, and it is interesting to consider why this is the case. It is almost as though we are unwilling to abandon a familiar story, even when it is known to be erroneous, if there is no satisfying alternative explanation to accept instead. Flawed explanations of a phenomenon are far more comforting to lean on than having to endure the unexplained (Shermer, 2002).

In a recent examination of the narratives we peddle about the creative mind, I adopted an approach that relied on understanding how these stories came to be and why they are so resistant to revision. What was revealed through this quasi-archival trawl was that behind every myth of the creative mind was a kernel of truth, and it was around each of these kernels that an enduring tale was spun (Abraham, 2024). In the sections that follow, I summarize the snapshot view or take-home message for three of the aforementioned seven myth-truths of the creative mind.

Myth/truth I: The creative right brain

The notion that the right hemisphere of the brain is the wellspring of human creativity in all its complex diversity is an idea that stemmed from the pushback against the dominant view in the mid-20th century that the left hemisphere was the superior and more important half of the brain as it was critically involved in the processing of language and purposive movement. Owing to the centrality of language in facilitating communication, community, and culture in our species, the left hemisphere was elevated to a position of neuro-primacy and began to be attributed other seemingly related functions like reasoning and intellectual ability (Harrington, 1987). Such generalizations meant that the counterpoints of these abilities, functions like instinct, animality, unconscious, passion, and madness, began to be automatically attributed to the right hemisphere. These circumstances set the stage for the enduring meme of the civilized left brain versus the untamed right brain. It was in against this backdrop, that an intriguing idea was proposed, albeit without much in the way of scientific evidence - namely that the right brain was the seat of imaginative thought that facilitated artistic expression, creative intuition, and dream states (Bogen, 1969; Bogen & Bogen, 1969). The world was agog in the 1960s and 1970s with the tantalizing discoveries of asymmetric hemispheric activity and the associated lateralization of psychological functions (Staub, 2016). This new hypothesis provided a charming fit to the incomplete puzzle about the larger relevance of the right hemisphere.

Despite the lack of consistent evidence to support the notion of the creative right brain versus the uncreative left brain over the several decades that followed, this view continued to persist. Even Joseph Bogen, the foremost proponent of the creative right brain hypothesis, revised his views in the 1980s and argued for the importance of *both* hemispheres in creativity (Bogen & Bogen, 1988), but to little effect. The neuroscientific evidence thus far indicates that several brain regions distributed across both hemispheres are involved in creative thinking (Dietrich & Kanso, 2010). Creativity is complex ability and involves a vast array of mental operations, some of which may be dominantly represented by right hemisphere regions, whereas others demonstrate left brain dominance.

Although the evidence on hand indicates that both hemispheres of the brain are vital for creative function, this creative right brain myth remains impervious to revision.

One possibility to consider in making sense of this state-of-affairs is that the creative right brain idea remains potent, not because it is accurate (Staub, 2016), but because it serves as a useful metaphor in our daily lives. For instance, calling someone 'left-brained' conveys to the listener that this is a person who is orderly, analytical and logical, whereas calling someone 'right-brained' instantly suggests that they are creative, imaginative and intuitive. The term can be therefore used to readily convey that characteristics typify creativity are associated with select systems (e.g., the curriculum of a school district), practices, individuals, collectives, and so on. So, the potency and persistence of the creative right brain idea perhaps lies in its function as a useful metaphor; it is one that enables us to understand and communicate with one another effectively by conveying complex meanings effortlessly.

Myth/truth II: Madness and creativity

The association between mental illness and creativity is longstanding and can be traced back to the religious and mythological traditions of ancient civilizations. Central to this notion is the idea of the 'daemonic' where the destructive (e.g., rage, fear) and constructive (e.g., creativity, growth) forces of nature are inseparable (Diamond, 1996). The core belief is that psychological suffering is the price one pays for the divine gift of creative insight and artistic productivity. Such a notion certainly resonated with the reported life experiences among swathes of eminent artists, such as British poets in the age of Romanticism (eighteenth-nineteenth centuries) and American writers of the modern era (twentieth century). Empirical examinations of mental health in prominent creative achievers also suggested that there was indeed some truth to this idea (Post, 1994). In fact, creative artists who relied more on emotional expressiveness, personal experience, and imagery (e.g., poets, actors) showed the highest degree of vulnerability to mental illness (Ludwig, 1995).

Although the madness and creativity association is the oldest of all the myth-truths concerning the creative mind, what has altered

over time is the specifics of which mental disorder is most strongly implicated within each historical period (Becker, 2001). The ancient Greeks tied creativity to depression whereas in our current age, the focus has is predominantly on bipolar disorder and schizophrenia, disorders that share many commonalities in terms of biomarkers (Yamada et al., 2020). Several strands of evidence lend support to the idea that these disorders are associated either directly or indirectly with creativity. For instance, a landmark study on Swedish population registry data from 300,000 people evaluated the likelihood of creative occupations being held by those who were diagnosed and received in-patient treatment for either schizophrenia, bipolar disorder, or unipolar depression (Kyaga et al., 2011). The findings demonstrated that odds of being in a creative profession were higher in people with bipolar disorder as well as in the first-degree relatives of people with bipolar disorder and schizophrenia.

While such findings appear to suggest that this is equivocal evidence for the truth of the link between mental illness and creativity, the reality is that the directionality of this association is still unclear. Does madness lead to heightened creativity or is the opposite true - that undertaking creative ventures makes one susceptible to mental illness? While the former case - namely, that there is a shared psychophysiological sensitivity that marks the mentally vulnerable and the creative artist (Abraham, 2014; Karlsson, 1970) - is the intuitive story that bears considerable narrative appeal, the latter case gets very little attention. This is surprising given that the precarity associated with creative professions is well-documented (Serafini & Banks, 2020). For example, artists are less likely to be in full-time benefits-associated employment as such opportunities are scant for such professions. Creative artists are also very vulnerable to the socio-economic vagaries of the time. This was evident most recently in the aftermath of the COVID-19 global pandemic as artists were among the most deeply disadvantaged professional groups who were unable to make a living due to the restrictions on their work activities (Marrone et al., 2020).

The unique burdens that accompany creative engagement at a professional level are also substantial. There is the pressure that the creator faces of having to generate an idea or product that they themselves consider to be creative (internal frame of reference) when needed. Coupled with

that is the related pressure of the fact that this idea or product must be experienced as novel and satisfying by a wider collective (external frame of reference) for the creator to have any level of success, standing, and stability in their profession. These chronic psychosocial stressors and environmental vulnerabilities associated with highly precarious professions render people who practice such occupations to be more susceptible to mental illness.

In this context it is worth bearing in mind that the 'tortured genius' notion did not generalize to all periods of creative productivity in history. The Italian Renaissance (fourteenth-sixteenth centuries) provides a valuable case in point as it was a time where mental stability, rather than mental illness, was associated with creative productivity (Robinson, 2011; Steptoe, 1998). Optimal systems of social support were in place for creative artists in Florence during this period, and the arts were viewed as high value professions. Such factors are believed to have promoted creative flourishing in this cultural context (Csikszentmihalyi, 2014). What is therefore evident from centuries of inquiry is that madness and creativity are certainly interlinked. However, the precise nature of their relationship is far from clear.

Myth/truth III: Psychedelic drugs and creativity

The earliest accounts of experimenting with psychedelic substances readily attest to the captivating and almost poetic nature of such experiences. Notwithstanding the great interindividual variability among people who undergo psychedelic experiences, there are some phenomenological parallels across first-person accounts, including vividness of imagery, a feeling of otherworldliness of the experience, an expansion of one's consciousness, the noticing of ordinarily disregarded features of one's sensory environment, a distorted sense of time, and a sense of profound personal meaningfulness to name (Griffiths et al., 2006; Schmid & Liechti, 2018). Havelock Ellis summarized the profound impact of his experience with psychedelics as follows: "I can, indeed say that ever since this experience I have been more aesthetically sensitive than I was before to the more delicate phenomena or light and shade and color" (Ellis, 1898, p. 141). Others have reported even deeper changes in relation

to beliefs and worldviews with some abandoning their atheistic views as a direct consequence of such experiences (Griffiths et al., 2019). The association between psychedelics and creativity derive from the capacity for such experiences to alter the way one perceives the outer world as well as one's inner world; in allowing one to see thing anew. There are also phenomenological parallels between the flow experience that typifies peak creative moments and those that occur after ingesting psychedelics, such as the merging of action and awareness, loss of self-consciousness, transformation of time, and the autotelic or self-rewarding nature of the experience (Bowers, 2017).

However, the actual empirical evidence on hand for psychedelics to enhance creativity is fairly limited. This is due a range of factors. For one, not everyone who takes psychedelic drugs has positive or uplifting experiences (Hartmann, 1974). Such stories, however, are not entertained in the public discourse as much because they are far less enthralling. Another limiting factor is that there are personality characteristics that people who take psychedelics and highly creative people have in common - both exhibit elevated levels of openness to experience, which is a core personality trait that is marked by characteristics like curiosity and aesthetic sensitivity. As studies on creativity and the psychedelic experience generally do not factor in the influence of this important personal trait in explaining the relation between the two, it remains an open question as to whether it is the openness to experience that is the key variable in facilitating creativity following a psychedelic experience or whether it is the psychedelic experience itself that plays the key role. Even though the use of such drugs is certainly more prevalent in creative populations (Iszáj et al., 2017), other non-creative professions that are also associated with similar or even higher usage rates (e.g., food industry workers) (Bush & Lipari, 2015). So, heightened drug use among creative artists does not in of itself support the association between psychedelics and creativity.

Aldous Huxley, an early experimenter with such drugs, in fact provided important insights about the use of psychedelics and the creative experience in an interview he participated in in 1960. He noted that during the psychedelic experience itself, one is so profoundly immersed in the moment that one would not be in the mood to actually do something productive, like write a poem (Wickes & Frazer, 1960). However, he

noted that psychedelic states could have an indirect impact on creativity after the experience as it has the capacity to alter the way one reckons with one's being and the world at large. Indeed, there is some evidence that quite subtly points to how such indirect impacts can come about, not during the psychedelic phase (directly following the ingestion of the drug), but at a later point either during the afterglow phase (a few days or weeks after the experience) or when examining long-term residual effects (Majić et al., 2015).

For instance, when examining the effect of psilocybin on creativity, the immediate effect of taking the drug was reduced creative performance. A week later though, the same participants reported having more ideas that were completely new to them (i.e., creative following an internal frame of reference) (Mason et al., 2021). Such findings reveal that understanding the potential impact of psychedelics on creativity necessitates the factoring in of other dimensions (e.g., temporal, personal) that accompany such experiences.

Concluding remarks

What deep examinations of the myths of the creative mind reveal is that we have chosen to accept simple stories that are easy to digest when trying to grasp the reality of a very complex phenomenon. The task we face then is to push ourselves to go beyond the surface narratives to find the real truth. This is more difficult to undertake than we realize. Nonetheless, when we exert ourselves to avoid the path-of-least-resistance of basic narratives, what can be discovered are the deeper and more fulfilling stories that lie beneath (Abraham, 2024).

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CREATIVE EDUCATION: A SYSTEMS PERSPECTIVE

Michael Hanchett Hanson *

Abstract

A leading edge of creativity research today involves the integration of systems theories into how creativity is conceptualized. This is a dramatic shift from the individualized testing approaches that have long emphasized simple ideational fluency. At this point, a good deal of analysis has provided frameworks for thinking about creativity in complex socio-historical, material, and technological systems, including the challenges of individuals doing creative work within those dynamics. How to approach education from these systems perspectives remains an important issue, and this article looks at how such frameworks would affect two different educational contexts: an art class about building designs in elementary school and a theater program for high school students.

A leading edge of theoretical work in creativity today is integration of complex system dynamics (for example, Beghetto & Corazza, 2019; Clapp, 2016; Glăveanu, 2014; Glăveanu et al., 2019; Hanchett Hanson, 2015; Hanchett Hanson & Clapp, 2020; Hanchett Hanson et al., 2021; Sawyer, 2010, 2011). These approaches can involve well-established developmental perspectives on creativity (e.g., Gruber & Wallace, 1999; Moran & John-Steiner, 2003; Vygotsky, 1978) and sociocultural approaches (e.g., Csikszentmihalyi, 1997; Glaveanu et al., 2019), along with embodied, extended, or distributed cognition (e.g., Clark, 2008; Hutchins, 1995; Salomon, 1993). Systems theories change the direction of creativity research. Simple ideation, focusing on individual thinking, has long been the focus of creativity research in psychology. Although such research may still find relevance in the new paradigm, the ability simply to generate ideas, operationally defined as a phrase or quick sketch

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with no specific context, is far from central to systems analyses (Hanchett Hanson & Clapp, 2020). Instead, the focus shifts to interaction dynamics, idea integration, and feedback loops over time.

For education, an appealing aspect of the old ideation approaches was that there were tests with age-defined norms (e.g., Torrance, 2008). The unfortunate irony was that efforts to move education away from meaningless evaluations of memory were basing their own success on equally suspect divergent thinking tests. Technically the current theorists leading divergent thinking research do not equate it with creativity, but too many researchers have been lax on this point, over-generalizing findings using these tests to evaluate "creativity" writ large (Hanchett Hanson, 2015). The correlational evidence supporting fluent ideation as core to creative work has produced low predictive validity (Runco, 2010). Furthermore, the theory does not align with considerable research on the domain specificity of creative thinking (e.g., Baer, 2010, 2012), nor more ecologically valid research of actual people doing creative work (see discussions, Weisberg, 2006; Hanchett Hanson, 2015).

The systems perspective

At this point a good deal has been written on how to conceptualize creative work as emergent from distributed thought processes in complex socio-historical systems, without losing sight of the value of individual contributions (e.g., Clapp & Hanchett Hanson, 2019; Hanchett Hanson et al., 2021). But how do we put that concept into practice in education? This challenge may sound daunting, but actually it is not so difficult. In practice, it can be easier to help students understand and practice creativity as an emergent property of complex systems than to carve out special time to brainstorm or use other ideation techniques. To make this shift, basic educational content does not have to change - same content and lessons in math, science, history, art, etc. How we think and talk about what we are teaching does change, however. We have to let go of insistence on ideologically-based focus on individuals when that perspective runs counter to the ways the world actually works. Instead, we can turn attention to how thought and experience is distributed across social, material, and technological interactions, as well as the impact of

those distributions. Again, the goal is not elimination of the value of individual points of view. Interactions of differing perspectives remain crucial. The emerging creativity of any system cannot, however, be *reduced* to isolated points of view, ignoring the larger dynamics.

Examples

That is the theory. But real-world examples are more instructive. Here, I will discuss two examples of how attention to systemic distributions of thought and practice can transform the students involved and their depth of learning - as long envisioned by advocates of creative education. These cases are from my own research and were key to transforming my own perspective on what creative education can actually accomplish.

Designing a neighborhood

I spent several years studying an art program in New York City public schools. In this program, sponsored by a prominent art museum, practicing artists worked with classroom teachers in elementary schools to teach inquiry-based art lessons. The lessons involved exposure to great works of art and related art projects produced by the students. This is an impressive program. The teaching artists are highly committed to the work and well trained to work in classrooms with elementary school students.

At one point, an experienced, particularly talented, and self-reflective teaching artist came to me with a concern. She had developed a lesson for third graders, designed to emphasize close observation of the students' own environment, as well as teach art-making techniques. The students spent time with the teaching artist walking around their neighborhood in Brooklyn and observing and taking notes on the architecture, classic New York City brownstones. This kind of housing was particularly popular in New York City in the 19th century, narrow attached houses each with stairs leading up to a main first floor, a lower level "garden floor" and 1-3 floors above the first floor. Such housing is often described as charming, not a word always associated with New York City. The students then went back to the classroom and designed their own brownstones, making woodcuts of their designs. Then they stamped their designs next to one

another on a long sheet of butcher paper, representing neighborhood streets that they had now designed (see also discussion of this project, Hanchett Hanson, 2019).

The lesson worked quite well. The teaching artist was concerned about the students' creativity, however. In spite of her repeated instructions for all of the students to come up with their own designs, the students openly copied from one another. Why were they not being more "creative"? Her question happened to tap into more than my understanding of creativity as a psychologist. I also hold a degree in architecture. What was happening in the class was more complex and representative of the real world than individual deviations in design reflected. The individual perspectives were at play, but the teaching moment concerned the emergence of *style*. For, architects copy from each other even while deviating in details and customizations for specific sites. Brownstones were built over a long period of time and differ from one another in all kinds of details - decorations of portals and fenestration, uses and designs of wrought iron, etc. Such details allow a trained architectural historian to date specific buildings and sometimes even identify the architectural firm that designed it. Such details thus locate the design in the history of the evolution of this housing style.

The lesson concerning style required the students to reflect on the history of style development in their own class. Which details of design were copied? Why? How did the replication of those details spread in the class? Why did some designers, nevertheless, not copy a particular detail and opt for others? How did social interactions and "geographical proximity" (here, placement of the students as they worked) affect the development of the class style? How did available materials (here, use of woodcuts) affect what design elements were copied or not? This kind of inquiry amounts to studying the *biographies of the ideas*, instead of the ownership of ideas, as Edward Clapp (2016) has recommended for realistic and inclusive classroom lessons on creativity. Note that, from this perspective, the lesson is still teaching observational and art-making techniques. Now there are added components, observing how individuals affect one another and how artistic medium affects content. In addition, the lesson now provided experience-based instruction on how certain aspects of the field of architecture works.

Finally, well beyond the control of the teaching artist, this could be a paradigmatic example of teaching creativity in general. For, there are also histories, trends, pressing and ignored questions in science, technology, math, history, literature, etc. Studying how ideas arise, are adopted, and then revised in these histories and in the classroom itself in studying these subjects is studying creativity.

Transforming trauma through theater

Another study, crucial to my own understanding of the distributed nature of thought, involved adolescents' understanding of their own experience. For five years I conducted mix-methods studies of several programs sites in The Possibility Project. (For detailed explanation of the research discussed here, including instruments used and statistical analyses, see Hanchett Hanson, 2021.) In these programs high school students from across New York City come together in an intensive program (six to eight hours per week for most of the school year) to create full-scale musicals based on their own experiences. A large percentage of the participants have experienced deep trauma. At the time of this research, about half of the young women and one-third of the young men had been victims of sexual abuse; over half had engaged in dangerous self-destructive behaviors; and 20% knew someone seriously injured or killed by gun violence. The play that the young people wrote then included hard-hitting themes such as gang violence, depression, self-harm, and incest, along with more garden-variety young romance and heart-break. Young people who have gone through the program consistently emphasize its transformative impact with statements like, "This program saved my life."

The research included pre-/post testing of the program participants (test group) and a comparison group on seven measures: initiating relationships, providing emotional support, asserting influence, self-disclosure to friends, conflict resolution, general self-efficacy, and sense of purpose. These findings were triangulated to structured observations of the programs and coded group discussions and participant interviews. Significant treatment effects were found for providing emotional support ($\beta = .21$, $p<.05$), self-disclosure ($\beta = .23$, $p<.01$), and conflict resolution ($\beta = .19$, $p<.10$). No treatment effects were found for the other measures,

likely reflecting self-selection by participants who chose to spend their time in this kind of intensive program.

My original hypothesis was that through the playwriting, the young people gained a sense of control over their stories, a self-authoring process. In the end, the interviews and observations provided almost no evidence to support this hypothesis. Instead, the young people repeatedly talked about the importance of sharing their stories and the power of the realization that they were not alone. The transformation was not in "owning" or taking control of one's experience but in distributing it. The trauma, the challenges, and the stories were experienced by individuals but belonged to a community.

When I went back to the program structure and my observation notes, these statements made sense.

- In the first session with about 100 young people from all over the city, most of whom do not know each other, the group brainstormed problems facing their generation. Each problem was written at the top of a large sheet of paper and those sheets were put on the walls around the room. The participants could then write a few words about their own experiences on post-it notes and place the notes on the appropriate sheet. One 15-year-old later remembered standing in front of the sheet on gang violence as the moment when everything started to change. At that moment he realized "I wasn't alone."
- The young people spent a few months going through exercises to build trust and share their stories. At the culmination of this process, each member had a few minutes to talk about some important experiences they have had. The other members of the cast did not respond, advise, or applaud. Their role was just to listen.
- Then the adult directors and a steering committee of members who had been through the process before drafted a very basic outline of the play with five storylines, each focusing on different problems. For example, a storyline about incest was a synthesis of different members' experiences, not the retelling of any one story. The cast members who had experienced incest were *not* cast in that storyline, however. Members of the cast were thus working through each other's issues.

- The story outline is very basic, and it is up to the cast to workshop the scenes, develop characters, and determine where to leave / how to resolve the story. Often, though, some cast members were absent. In the workshops, the cast members then had to cover for each other, which could be an intensive exercise in perspective taking. For example, the person playing the victim of incest might have to play the perpetrator of the offence in these rehearsals.
- At the end of months of story development and rehearsal, came the performances in an actual New York City theater. The audience was largely family and friends, thus many of the people implicated in the stories. In this situation it was important to be explicit in telling the audience that, although the stories reflected actual cast members' experiences, these were not their individual stories. These were the stories of a *community* of young people and the issues they face.

Conclusion

This paper has recounted research in two very different contexts with different student populations and different educational objectives. One was a lesson within a school art program for 3rd graders, and the other, a non-school based, after-school program for high school students. Creativity was important to both. The projects themselves were creative endeavors: designing buildings and writing and performing a play. Individual ideation was happening almost continuously. In both cases, people were observing, remembering, elaborating, planning, revising, etc. As creativity researcher Robert Weisberg (2006, 2011) has argued, these are ordinary thought processes put into the contexts of creative endeavors. There is no special way of thinking creatively, but there is the long-term integration of ideas into the details of building plans or the writing and performance of a script. The only time a divergent-thinking type exercise is used in these examples was the first session of The Possibility Project when the group of 100 students who did not know each other brainstormed challenges they and their communities faced. Note, however, the brainstorming was not to come up with creative ideas. Decades of brainstorming research have shown that the process does

not produce more good ideas than people working alone. Educational researchers have, however, noted that brainstorming can serve important functions, such as priming knowledge that would not otherwise be top of mind, giving instructors information about student understanding, and building group cohesion (Baer & Garrett, 2010). Those are exactly the functions the technique served in this case.

Individual perception and ideation are an ongoing process, but ideas can be quickly lost if not reinforced by speaking, writing, sketching, etc. (Nijstad, Diehl, & Stroebe, 2003). Such reinforcement is part of the social and material distribution of thought. It is just such systemic distribution of creative meaning making and the metacognitive recognition of those distributions that are crucial to new understandings of the world, of self, and of creativity in these very different cases. We can move beyond simple ideational techniques designed to meet the standards of the questionable tests of divergent thinking and, instead, ourselves start thinking about what we are teaching as distributed systems. If we do, the results can be greater impact and greater relevance to the real world. We might finally begin to make good on the educational visions that creativity rhetoric has long advocated.

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USING ADVERSARIAL COLLABORATION TO HARNESS COLLECTIVE INTELLIGENCE AND BOOST CREATIVITY IN SCIENCE

Lucia Melloni *

Abstract

There are many mysteries in the universe. One of the most significant, often considered the final frontier in science, is understanding how our subjective experience, or consciousness, emerges from the collective action of neurons in biological systems. While substantial progress has been made over the past decades, a unified and widely accepted explanation of the neural mechanisms underpinning consciousness remains elusive. The field is rife with theories that frequently provide contradictory explanations of the phenomenon. To accelerate progress, we have adopted a new model of science: adversarial collaboration in team science. Our goal is to test theories of consciousness in an adversarial setting. Adversarial collaboration offers a unique way to bolster creativity and rigor in scientific research by merging the expertise of teams with diverse viewpoints. Ideally, we aim to harness collective intelligence, embracing various perspectives, to expedite the uncovering of scientific truths. In this talk, I will highlight the effectiveness (and challenges) of this approach using selected case studies, showcasing its potential to counter biases, challenge traditional viewpoints, and foster innovative thought. Through the joint design of experiments, teams incorporate a competitive aspect, ensuring a comprehensive exploration of problems. This method underscores the importance of structured conflict and diversity in propelling scientific advancement and innovation.

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PSI AND CREATIVE IMAGINATION

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This paper looks at how we can build bridges between the creative mind - our imagination - and psi phenomena.

Creativity, per the American Psychological Association, is the ability to produce or develop original work, theories, techniques, or thoughts. A creative individual typically displays originality, imagination and expressiveness. Creative thinking refers to the mental processes leading to a new invention or solution to a problem.

Psi phenomena, e.g. extrasensory perception (ESP) and clairvoyance, are experiences that transcend our understanding of the usual senses and consciousness. Schlitz & Gruber (1980, 1981) conducted research on the link between creativity and psi phenomena, specifically on the topic of remote viewing. These studies involved having one participant imagine the location of the other participant and sketch and describe the location. Schlitz & Gruber found that participants were able to produce sketches and descriptions that judges deemed accurate at a significantly high frequency. Schlitz & Haight (1984) replicated these studies with similar results.

Arnaud Delorme's (2023) book *Why Our Minds Wander* provides the framework for thinking about daydreaming and how a wandering mind can be conducive to both parapsychology research as well as our understanding of creativity and psychology. This book asks: when our mind wanders, are we wandering ourselves or is there something separate that contains the wandering mind? This raises a fundamental question about consciousness and what is happening inside (and perhaps beyond) the brain. Is there a possibility that somehow our consciousness can reach out in time and space in ways that have yet to be fully understood, given contemporary science? The concept of mind wander can be applied to the acquisition of information in the context of such research protocols as remote viewing, and very much speaks to my own personal experiences.

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The history of studying psi phenomena and creativity began in 1882 at the British Society of Psychical Research. This society consisted of scientists interested in studying mediumship, as well as remote viewing types of experiences. The American Society for Psychical Research was founded in 1884. Frederic Myers was one of the first people to make the connection between exceptional human abilities such as genius and psychic abilities. He was particularly interested in spontaneous cases - people who had dreams, for example, where they were able to predict an event that would happen in the future. He concluded that both creativity and psychic experiences are characterized by an uprush from the subliminal mind into conscious awareness. One of Myers' main findings is that mental imagery became a dominant tool or a kind of epistemology for gaining information.

Sigmund Freud and Carl Jung had a long series of correspondences wherein they attempted to understand how their patients gained information through telepathy or clairvoyance. This spontaneous reception of information associated with psi shares similarities with the subconscious processes that underlie creative thinking. Jung argued that creativity can be enhanced by understanding psychic phenomena.

Eugene Taylor (1999) looked at the emergence of ideas surrounding psychic phenomena as they were studied in the 1800s and early 1900s. Many artists and renown creatives have reported psychic experiences: Mark Twain, Robert Browning, Robert Schumann, Van Goethe, Yoko Ono, and Taylor Swift have talked about how intuition plays a role in their abilities to produce art.

There are psi conducive states in creativity, in which phenomena like hypnosis, daydreaming, and imagery can be useful in producing psi in a laboratory setting. There have been reviews of literature that have looked at this and found that there are various ways in which methodological issues, theoretical frameworks, and empirical findings from these two domains - psychical research and creativity - that may lead us to a greater understanding of who we are and what we're capable of becoming.

One of the studies I did (Schlitz & Honorton, 1992) was conducted at the Juilliard School of the Performing Arts. We ran Ganzfeld experiments. The Ganzfeld protocol is a means of thinking about how you can access the unconscious mind. In this case, we could look at these

creative populations and see what there was to learn about psi in this group. These experiments involved putting a person in a state of sensory deprivation. It involved placing halved ping pong balls over their eyes. There was a red light that shone down over them. They were asked to keep their eyes open, but they had no sensory input. In such a situation, the brain starts manufacturing imagery. So, the participants could have rich unconscious experiences. Someone in another room was watching a video clip. At each session, four target videos were selected at random. The person watching one of the videos would describe the video to the sensory-deprived participant, who would later have to select which of the four videos was the one being described. For example, one of the sessions had a person watch a clip from *The Wiz* (a 1970s musical adaptation of *The Wizard of Oz* starring Diana Ross as Dorothy). The film clip showed Dorothy, the Lion, the Scarecrow, the Tin Man and the little dog walking across the Brooklyn Bridge, all tinted yellow. At the beginning of the clip, a hot air balloon pans over. The person in the ganzfeld state, completely unaware of what the actual video clip was, described a hot air balloon, a black female nightclub performer, a lion, a dog and repeated described the sense of the color yellow. The yellow was the yellow brick road. It was not challenging at all for her at the end of the session to take off these eye shields and select the correct clip of the four.

At the time we did this, the Ganzfeld experiment had about a 33% success rate. A one in four probability, on the basis of chance, would yield 25%. Yet the ganzfeld experiment was producing a 33% success rate, which is statistically significant. The Juilliard students produced a 50% success rate, with the classically trained musicians producing a 75% success rate.

We found significant correlations of psi and creativity and significant correlations in flexibility and elaboration. People seem to have a kind of cognitive fluidity. Creativity often involves seeing things from unconventional angles or perceiving beyond the obvious, similar to the way psi experiences might involve information beyond typical sensory details. The idea of the receptive mind shows up in both psi and creativity. Psi experiences might emerge from a broader receptive mode of consciousness, including openness to unconventional ideas, intuition, and insight.

Gardner Murphy was one of the early researchers working with JB Ryan, attempting to bring this idea of psychic phenomena into a controlled laboratory setting. He wrote, "creativity and psychic experiences are twin expressions of a dynamic, unconscious, emotional, and instinctive life" (1963:206). Researchers over more than 100 years have looked to find the similarities between these states. Anomalous cognition and psychokinesis with unselected creative writers was studied using standardized tests of ESP and psychokinesis. These results again suggest that individuals with a high level of creative achievement may also demonstrate enhanced side performance.

Another approach I have considered is the psychomantium, a protocol that makes use of an ancient technique of mirror-gazing or gazing into a reflective surface. For example, the Temple of Delphi in Greece, where heads of state would consult with the oracle about what they should do; the oracle would gaze into a reflective pool and attempt to gain reliable information that could help the heads of state in their enterprises. Raymond Moody (1992), a psychiatrist, brought the psychomanteum into a laboratory or clinical setting. Moody was interested in using this kind of divination tool to work with patients undergoing severe grief. My colleague Arthur Hastings, and his colleagues (2002) began to do formal research using the psychomanteum at the Institute of Transpersonal Psychology at Sophia University. His interest was in finding people in a state of bereavement and asking them to gain contact with departed loved ones. He found that there were significant correlations between the ability to move through grief and with absorption. In other words, how deeply does the person feel that they're getting into this kind of communication with their departed loved ones? One of the things we did in my research (Schlitz, et. al., 2025), was to compare the psychomantium chamber and a Virtual Reality experience using an induction to encourage creative imagination. Besides looking at the quantitative results we observed with scales of grief and absorption, we also conducted interviews and collected short journaling exercises, to look at the qualitative details. The range of reported experiences is fascinating. People might encounter an identity, a person, maybe their departed loved one, maybe in a group of different people. When I did it, for instance, I was in a quiet room and I had an experience where there was a bunch of people talking. I asked my

co-experimenter after the session whether a bunch of people had just come by, but he reported that it had been absolutely quiet. Something in this projective technique of, in this case, gazing through a virtual reality headset at a reflective surface, was conducive to these kinds of experiences in multiple sensory ways. Some people experienced nothing. Others had a profound sense of sadness. A number of people reported a release. Many of the participants described the desire to continue. The psychomanteum became a kind of transformative practice and it becomes a way of engaging the creative imagination.

What are the next steps in this research? There are many ways to consider the connections between psi phenomena and creativity. The study size for both topics must be expanded to increase the effect sizes, thus enhancing the reliability of the results. It can be difficult to draw correlations with limited samples. There are needs for assessments that cover a broader range of dimensions of creativity and better tools for replicating psi under controlled conditions. There is also a need for more systematic meta-analyses that would allow us to better understand the effect sizes and systematic replications, perhaps enhanced with adversarial collaboration. In the meantime, this remains a rich and fertile field of study. My next study involves talent and training in the psychomantium, examining high and low absorption and doing repeated testing with the Virtual Reality protocol. In this way, we can deepen our understanding of psi experiences and the creative imagination.

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THE IMPROVISING BRAIN: IN SEARCH OF MEANING MAKING AND THRIVING

Morten Kringelbach [*]

Abstract

A meaningful life requires constant improvisation in the face of adversity. From a neuroscientific perspective this requires a deep understanding of how the brain is able to efficiently orchestrate the distributed computation of information, allowing for optimal hierarchical information transfer at the lowest metabolic cost across the whole brain. This is important since suboptimal brain orchestration can lead to problems with mental health and diminished experience of meaning and joy. The interdisciplinary research in *Centre for Eudaimonia and Human Flourishing* aims to achieve a breakthrough in understanding the brain orchestration of thriving and meaning making by studying meaningful stimuli such as social interactions, music, meditation and psychedelics with large-scale neuroimaging data and whole-brain modelling. This is already providing new insights into how best to balance the brain orchestration of human flourishing in health and disease.

Introduction

At the heart of our lives lies a deceptively simple question, namely 'what is the meaning of life?'. This question relates directly to existential questions of how best to live our lives so that we, other species and our small blue planet can flourish together. Over the millennia, many have looked for answers and have in the process given birth not only to art but also to philosophy and science. Still finding the answers is becoming

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more and more urgent in these difficult times of severe mental health problems, mass extinction and climate catastrophe.

This simple question has been guiding my research over the past decades. I have used many different scientific methods to try to shed new light on how the human brain creates deeply subjective states, including the underlying meaning making processes giving us a sense of purpose - and ultimately flourishing. It remains an exciting journey that has yielded significant progress in identifying many of the underlying brain mechanisms and networks for related, highly subjective phenomena such as emotion and pleasure that were once deemed as being outside the realm of science.

The wisdom of Aristotle has been a guiding light in this process, especially his proposal that a meaningful life consisting of the dual aspects of hedonia (pleasure, from the ancient Greek 'hedus', the sweet taste of honey) and eudaimonia (a live well-lived, embedded in meaningful values) [1-4]. This distinction inspired me to first create a neuroscience of pleasure using the sensory pleasures such as food and sex in humans and other animals. This research programme allowed me to investigate subjective brain states such as emotion, pleasure and pain [5].

Over time, I became emboldened to start going deeper and aiming to understand eudaimonia. To this end, I created the *Centre for Eudaimonia and Human Flourishing* in *Linacre College* at the *University of Oxford*. Here, we are moving beyond hedonic stimuli to interdisciplinary investigations, bringing together science with other domains of knowledge such as music, which evokes strong emotions and even meaning, especially during improvisation. In fact, this interdisciplinary science has now matured to the point, where we may finally be at the verge of understanding some of the core principles of meaning making and flourishing in the human brain.

In time, this interdisciplinary science of flourishing will hopefully help to provide novel treatments for the pervasive suffering facing large parts of the world today. We are now at an inflection point where we have a fuller understanding of what goes awry in neuropsychiatric disorders, how the lack of pleasure, *anhedonia*, and the lack of motivation, *avolition*, causes the malignant orchestration of brain dynamics to wreak havoc on our mental health. Using sophisticated causal whole-brain models, we are

getting much closer to be able to find the orchestration of the healthy brain and better ways of rebalancing in disease; from direct brain stimulation helping those with chronic intractable pain to psychedelics having a significant impact on treatment-resistant addiction and depression.

A science of pleasure

Back in 2007 when I started as an independent investigator and setup my Hedonia lab, I chose to focus on emotion and especially the hedonic processing linked to pleasure. To this end, I was inspired by the pioneering research by American neuroscientist Kent Berridge from University of Michigan, USA. Berridge had convincingly shown that even though pleasure has both subjective and objective aspects, objective 'liking' can be studied even in animals and human infants by measuring behavioural affective expressions to pleasurable stimuli [6]. Using rodent orofacial expressions to sweet or bitter tastes, Berridge was able to demonstrate that stimulation with opioid and endocannabinoid neurotransmitters in specific 'hedonic' hotspots in the nucleus accumbens enhanced hedonic 'liking' reactions to pleasant sweetness. In contrast, he found that the motivational aspect, 'wanting' or the incentive salience of reward, can be measured by the amount of work the rodent will expend and that this was affected by mesolimbic dopamine, which did not change the 'liking'. In a series of elegant studies, he went on to demonstrate that 'liking' and 'wanting' are different in their underlying brain circuits.

Using human neuroimaging, I have investigated brain mechanisms of pleasure and wanting in humans. Importantly, my neuroimaging research samples the activity in the whole brain and allows for the study of the subjective components of liking and wanting by obtaining subjective ratings. This research was part of establishing a *science of hedonia* where robust hedonic stimuli (such as, for example, sugar taste, strawberry odours as well as infant faces and vocalisations) are used to reliably identify the core brain networks involved in hedonic processing, in particular the affective core of regions evaluating positive and negative stimuli, selectively captured by attentional processes and made available for appraisal [6]. Over time, this research has shown how hedonic brain processing changes over time, going through a 'pleasure cycle' consisting

of appetitive, consummatory and satiety phases [7, 8] and intimately linked to the necessary learning needed for survival (Figure 1A). The dissociable brain networks and mechanisms responsible for wanting, liking and learning of rewards have over time been linked to more and more specific regions and neurotransmitters (Figure 1B), which help orchestrate the phase transitions within the pleasure cycle.

More recently, the research has advanced so far that the brain circuitry in rodents can be directly manipulated such that they will, for example, behave in counterproductive ways to want what hurts. Using optogenetics, Berridge and colleagues stimulated the central nucleus of amygdala to make the animal voluntarily approach and repeatedly touch a laser-paired shock rod, despite receiving multiple electric shocks, as a prototype of addictive motivation where excessive 'wanting' becomes independent of 'liking' [9].

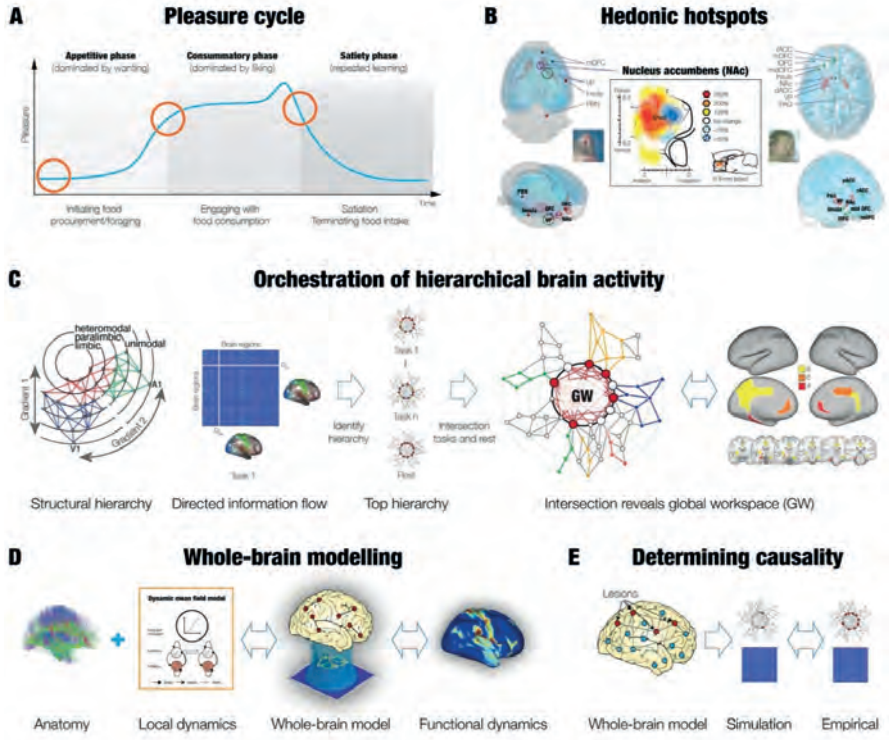

Figure 1. The neuroscience of pleasure and flourishing.

A) The pleasure cycle is driven by both fundamental (such as the food need for survival) and higher order pleasures (such as music). Rewarding moments begin with a phase of wanting for a reward such as coffee. This leads to a phase of consummation of the desired reward, which often has a peak level of pleasure. The consummation phase is usually followed by satiety, where we learn and update our predictions for the reward upon future encounters - although learning can take place throughout the whole cycle.

B) The liking phase is dependent on specific hedonic hotspots (blue) and coldspots (red) that can enhance or suppress pleasure. Berridge found such hotspots in regions of rodent brains such as the ventral pallidum (VP), orbitofrontal cortex (OFC) and nucleus accumbens (NAc) [6]. Within the NAc (medial shell) there is a highly specific map of hotspots and coldspots established with opioid agonist microinjections.

C) Moving beyond this specific pleasure engine to an understanding of whole brain orchestration, careful anatomical studies have found that brain connectivity is hierarchical in nature, with gradients from unimodal sensory processing (in blue and green) to heteromodal higher cognitive processing (in red). The hierarchical information flows on top of these directed anatomical routes can be determined from the bidirectional flow of information between any two brain regions, resulting in an asymmetric matrix of the information flow across the whole brain. At the top of this hierarchy, we defined the functional rich club (FRIC) orchestrating activity as the smallest set of brain regions that integrate function in a given task. Subsequently, a general 'global workspace' orchestrating brain function was determined as the intersection of FRICs from cognitive tasks and rest and consists of subcortical and cortical midline regions of the brain [23].

D) Progress in understanding causal human brain function depends on whole-brain modelling, which combines structural connectivity (obtained with diffusion MRI) and local dynamics (for example a dynamic mean field model) to fit empirical neuroimaging data.

E) Similar to animal models, lesioning the orchestrators in this 'in silico' model can be used to provide causal evidence of the underlying mechanisms.

F) The Centre uses five main experimental routes (sensorium, nurturance, music, psychedelics and meditation) to robustly elicit flourishing and meaning making in human neuroimaging experiments. Examples of the robustness of music in meaning making and flourishing can be seen in the photos. In order to reveal the general brain orchestration of flourishing, we propose a strategy similar to that used for revealing the global workspace, that is creating the intersection of the main orchestrators for each experiment eliciting flourishing.

Journey to a science of flourishing

Importantly, breakdown in the orchestration of the pleasure cycle can lead to *anhedonia* and *avolition*, core features of neuropsychiatric disorders including depression and schizophrenia [10, 11]. This has led to an increasingly detailed scientific understanding of the roles of and transitions in the pleasure cycle between brain regions and networks. This has begun to be leveraged to produce novel treatments of disease. Still, it is important to realise that the links between pleasure and well-being are not straightforward [12], and more pleasure does not always equate with higher well-being. In fact, it is the obsessive pursuit of pleasure that all too often leads to addiction and great unhappiness.

The research clearly shows that states of well-being require a fully functioning pleasure system; an engine room essential for enabling the necessary, orderly transitions through the pleasure cycle. So, while targeted treatment of a malfunctioning pleasure system may help bring the brain closer to a healthy state, this may not help with meaning making, a hallmark of true states of flourishing.

But meaning making is difficult to define and to study scientifically. We still lack a full understanding of how the healthy brain makes meaning, often occurring during the relatively rare visits to states of flourishing. Some have claimed progress through the questionnaire-based research of positive psychology, which over the last few decades has gathered evidence on subjective self-reports of happiness and life-satisfaction [1, 13-16]. This has led to the creation of a 'happiness index' of countries, where people in top countries will self-report high levels of 'happiness'. This research has helped define multiple domains of flourishing, but it has not yet yielded new insights into the underlying brain mechanisms. Worryingly, these high self-reported scores of happiness in some countries do not cohere with the severe mental health problems measured through for example depression and suicides in the same countries.

Perhaps, as has been suggested, we truly are strangers to ourselves, or, at the very least, perhaps not willing to - or sure how to - use these scales truthfully. Similarly, when we sing "if you are happy and you know it, clap your hands" and are forced to introspect, we all too easily lose such happy moods. In fact, it has proven rather difficult to reliably induce

meaningful flourishing states both outside and inside neuroimaging scanners.

Instead, it is clear that there are in fact certain classes of stimuli and experiences that can reliably lead to meaningful states. Music is an excellent example of stimuli that can elicit both joy, meaning and a whole host of related complex emotions [17-19]. Importantly, musical paradigms can be very precisely controlled and repeated over and over again, providing a key scientific route to study deeply subjective flourishing experiences [17]. When combined with neuroimaging, music is an essential tool for probing the hierarchical flow of information in the brain [17-19], tracking how sequences of sounds arrive at the peripheral sensors in the ear and move through a hierarchy of brain processing from the brainstem, thalamus and primary auditory cortices to higher order brain regions including the prefrontal cortex [20]. This is an active process, where music eventually engages the very top of the brain hierarchy, enabling the orchestration of the joy and even meaning of music, as defined by Patel: "Meaning exists when an object/event brings something to mind other than the object/event itself" [21]. As such, music is an ideal tool for revealing the hierarchy of the brain and the orchestration of thriving and meaning making. So together with Professor Peter Vuust, I founded the Center for Music in the Brain (MIB) at Aarhus University in Denmark to study music in the brain.

Another example are the social interactions and especially those with infants which can lead to joyful and deeply meaningful states. Back in the early 2000s, I had the idea to use the high temporal resolution of magnetoencephalography to study adults' positive reactions to cute infants. I discovered a brain mechanism for 'cuteness ignition', whereby both the sight and sound of infants have privileged access to our brains, igniting activity in the orbitofrontal cortex at around 130ms, which is before we become conscious aware of infants [22]. By the time we are aware of the infant, our brain is already captured by their presence and ready to engage in meaningful ways.

These and other research avenues including meditation and psychedelics opened up for the possibility of the scientific study of meaning making, flourishing and eudaimonia. Philanthropic funding from two international charitable bodies, the Pettit Foundation and Carlsberg Foundation allowed me to setup an endowment in honour of

the late psychologist Erel Shalit and establish the *Centre for Eudaimonia and Human Flourishing* at Linacre College, one of the constituent colleges of University of Oxford. Importantly, while the Centre is also closely linked to the Department of Psychiatry, being part of Linacre College directly brings in the inherent interdisciplinarity of an Oxford College, where the students and fellows come from all the different knowledge branches of University of Oxford.

My Centre has members from science, art and humanities; each bringing their own unique perspectives which are synergistically enhanced through conversations and collaborations with other members. We have weekly hybrid seminars (available in an online library), ranging from writers and artists-in-residence discussing their artistic practice to philosophers and anthropologists providing philosophical and social perspectives on flourishing to scientists discussing their latest breakthroughs in complexity science. After the seminars, much time is spent further discussing problems and exciting intersections over delicious coffee and chocolates, both important constituents of true flourishing.

The neuroscience of flourishing taking place in the Centre leverages the newfound possibility of establishing the orchestration of the hierarchical activity for different brain states in generating meaning. State-of-the-art frameworks help determine the hierarchy of the functional processing unfolding on the underlying hierarchical brain structure. This activity orchestrates the orchestration of the essential segregated and integrated information processing that promotes both survival and thriving.

As an example of conscious brain orchestration, together with my close friend Prof Gustavo Deco of Pompeu Fabre University, Barcelona in Spain, we recently used large scale human neuroimaging to identify the common 'global workspace' [23]. Using an information theoretic framework, we discovered the common 'conductors' across different brain states (Figure 1C) by determining the intersection of the brain regions at the top of the hierarchy in resting state and seven tasks designed to cover human cognitive flexibility. Crucially, we were able go beyond these correlations by using our paradigm of whole-brain modelling which has been shown well-suited for discovering the underlying mechanistic principles of brain activity given that each of the model elements can be precisely manipulated and the causal consequences characterised [23-25]. We

confirmed the causal significance of this 'global workspace' by lesioning a causal whole-brain model and showing that the regions are causally important to proper orchestration (Figure 1D-E).

More generally, this intersection strategy is used in the Centre to identify the orchestration of flourishing. To this end, we use five main types of experiments that reliably elicit meaning making and flourishing in humans. In addition to music, sensorium and social interactions, we also study the brain states elicited by meditation and psychedelics (Figure 1F). Especially psychedelic experiences are often rated by people as among their five most meaningful experiences. One person reported "… to 'let go' and become enveloped in the beauty of - in this case - music - was enormously spiritual" while another stated "… I realised I was glad to be alive. I've always thought I wouldn't be able to feel that". But how is this meaning making orchestrated over time independently of state?

Given the difficulty of eliciting transient states of flourishing, identifying their orchestrating conductors rely on our ongoing development of novel scientific frameworks of thermodynamics, turbulence and harmonics. Coupled together with whole-brain modelling, this has already yielded new insights. As an example, we used a thermodynamics-inspired paradigm to reveal that, contrary to expectations, movie-watching results in a flattening of the brain hierarchy compared with both resting and tasks. This temporary eudaimonic relief from the rat race of existence is perhaps one of the reasons why watching films is a preferred relaxing pastime for many of us [26].

Conclusion

The *Centre for Eudaimonia and Human Flourishing* is dedicated to spearheading a new interdisciplinary science of pleasure and flourishing by pushing forward in our mission to help find ways to make better lives. But many complex questions remain. They will require much more than just a bit of research in a Centre based in a small city on a large flood plain at the confluence of seven rivers. We have therefore recently established the *International Centre of Flourishing*, linking even closer related research in Oxford, Barcelona and Aarhus. Our research is conducted in the spirit of 'nit nitay garabam' (Wolof, 'people are people's medicine') underlying

true flourishing. Continuing on this journey, we hope to inspire and flourish the next generation of artists, philosophers and scientists.

In the words of John Steinbeck and marine biologist Ed Ricketts [27], human existence is marred by the "tragic miracle of consciousness" and our "species is not set, has not jelled, but is still in a state of becoming". We must seek better ways of finding meaning in life in the now rather than worry about the unchangeable past and uncertain future. We hope that many of you will join us in this interdisciplinary endeavour given that our very future - and that of other species and our tiny blue planet - will depend on it.

Acknowledgements

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Links

Centre for Eudaimonia and Human Flourishing: http://hedonia.kringelbach.org.

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THREE LESSONS FROM NEUROCINEMA

Sergio Neuenschwander [1] & Jerome Baron [2]

Abstract

Cinema, a unique and creative art form, offers an immersive reality experience unlike any other. In this short review, we discuss into how movies challenge commonly held notions of image representation by the brain. Vision, often simplified into basic stimulus-response processes, is enriched by the context of embodied experiences. We propose that the cinematic experience provides a singular and valuable framework for investigating crucial issues in contemporary vision sciences, such as perceptual binding and attention. Furthermore, we explore how studying perception through film phenomenology can be an effective way to teach the biological foundations of vision.

Figure 1. Frame from *Amarcord* (00:17:09) by Federico Fellini, 1973. Camera by Giuseppe Rotunno; produced by Franco Cristaldi; distributed by Warner Bros.

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In a memorable scene from *Amarcord* (1973), Fellini employs a low camera angle to film a scene in a classroom setting (Figure 1). Positioned behind his desk, surrounded by a fortress of books, a teacher wields his stick, loudly expelling a student (who remains unseen in the frame). At this very moment, the camera, tracking the action, swiftly moves towards the menacing object. The entire sequence unfolds in tune with the teacher's authoritative utterances, which carry the force of a locomotive. The scene could not be more dramatic and impactful.

What Fellini offers us here is the essence of cinema. His cinematography, as seen through his lens, is not a mere cyclopean record of a scene. Instead, Fellini creates an inversion of perspective with great emotional density through subtle yet powerful elements - such as camera angle, movement, and impactful audio. As the camera shifts, the viewer is no longer a distant observer but rather steps into the shoes of the protagonist, feeling their fear, even though none of this is explicitly shown. It is this visceral immersion that renders cinema a transcendent experience.

About a decade ago, we introduced an undergraduate course at the Federal University of Rio Grande do Norte, Brazil, titled *Neurocinema*. The course aims to bridge basic concepts of visual mechanisms and filmmaking, explaining how principles of visual brain function resonate with cinematographic techniques like image composition, *close-ups*, stabilization and camera movements, editing cuts, and narrative focus. Our intention was not just to analyze films from a neuroscience perspective but to spark a debate about the nature of perception, using the first-person experience in cinema as a benchmark. This brief review explores three critical topics covered in the course, which demonstrates how films may contribute as a rich experiential domain for investigating perceptual mechanisms.

Cartesian eyes

The first immediate problem that cinema and photography pose is related to the concept of image representation. The eye works as a miniature projection room. It is fitted with an intricate optical system that projects light onto the retina, much like a cinema projector casts

film images onto a screen. Inspired by the notion that eyes work as *camera obscura* (a concept derived from Kepler), Descartes introduced a revolutionary idea: the images projected at the back of the eyes are recorded by a sophisticated mechanical system that extends deep into the brain (Descartes, 1637). He conjectured that these actuators transform the image through successive stages, ultimately converging at a single organ (the pineal gland), where the brain and mind intersect. According to Descartes, perception should be understood as a process of mechanical interactions in which the image - seen as a mosaic of points - is represented in the brain. As Anne Friedberg (2009) points out, just as the Cartesian concept views the eyes as windows to the world, cinema functions similarly, with the screen acting as a window to an enacted world.

It is perhaps not by chance that the first known photographic record was made at the edge of a window. Joseph Niépce used a zinc plate coated with bitumen in a dark chamber, exposing it for several days to capture a faint yet discernible image of trees and rooftops. His innovation and the subsequent advancements in photographic and cinematographic cameras echo Descartes' vision mechanisms. This same principle of image representation forms the basis of current digital camera technology, where the pixel, determined by the camera sensor, is equivalent to the emulsion grain in traditional film. In this sense, photography can be considered an instantaneous, point-by-point record of a scene's light (luminance) levels.

The Cartesian concept of neural image representation, referred to as the *Cartesian Theater* by Dennett (1991), has significantly influenced neurobiology, shaping several key ideas. The discovery of cortical maps is a paradigmatic example. It was found that the visual cortex contains multiple representations of the visual field, which transform the topological relationships of the retinal image in a hierarchically organized manner (Lima et al., 2023). These findings have led to the development of a visual system model composed of dozens of interconnected areas, each responsible for different processing stages (Felleman & Van Essen, 1991).

Another significant conceptual leap occurred with the discovery that cells in the frog retina do more than generate light intensity maps; they can also detect ecologically relevant visual patterns, e.g., insects (Lettvin et al., 1959). Beyond a simple mapping device, the retina -

and, by extension, the brain - came to be understood as a network of computational units representing various aspects of the visual scene. This notion inaugurated an extensive research program dedicated to analyzing the response properties of individual neurons, leading to groundbreaking discoveries. In the rabbit retina, cells sensitive to movement direction were identified (Barlow & Hill, 1963). In the visual cortex of cats, cells that respond specifically to the orientation of contours were discovered (Hubel & Wiesel, 1962). In the inferior temporal cortex of monkeys, cells were found to be responsive to faces (Gross et al., 1972) and, even more specifically, to facial expressions (Tsao et al., 2008). Eventually, the term *grandmother cells* emerged as a serious joke, proposing the existence of neurons situated higher up in the visual hierarchy and precisely tuned to the image of a singular object (Quiroga, 2005). Single cells, defined by their unique response properties, would function as detectors, capable of identifying features or objects in the visual world - from colors and shapes to leaves, forests, and animals. In other words, compelling connections were established between optimal stimuli of higher-order neurons and correspondent *perception units*. This representational scheme emphasizes the brain's ability to form generalizations and develop abstractions at the cellular level (Barlow, 1972).

Nevertheless, this raises a fundamental problem: How does having multiple and distributed representations of different features translate into the experience of seeing a coherent scene? What processes link bits and pieces into a rich, conscious experience of a unified object? This fundamental issue, known as the *binding problem*, has long been a subject of fascination and debate, bridging the gap between science, philosophy, and art.

The illusion of movement

A film is a sequence of still photograms, or frames, projected rapidly. Typically, films are shown at 24 frames per second (fps), though modern technologies can use higher frame rates. In these viewing conditions, our visual system merges the static images into a fluid experience of smooth motion. This very illusion creates, to a significant extent, realism in the cinematic experience. When the Lumière Brothers premiered the first

movie in history, *Arrival of a Train at La Ciotat Station*, in 1895, legend has it that people genuinely feared the train would cross through the screen. Such an impactful experience certainly poses essential questions about the intricate workings of the brain and the nature of perception. It also motivates profound incursions into philosophical territories, questioning the very nature of reality and how it presents to us. If our perception of cinematic motion is an illusion created by our brains, what does this say about our perception of motion in the real world? Are we constantly building and filling in gaps in our everyday visual experience, much like when watching a film?

This problem, widely debated by cinema theorists, is more complex than it seems and is not merely about the persistence of images in the retina, as some textbooks still claim. One might conjecture that the relatively slow decay of neuronal responses in the retina would result in a certain persistence of the image, leading to a blurring effect in perception. However, under normal viewing conditions, we generally do not perceive blurs or persisting trails in our everyday visual experiences, including when watching films. Therefore, in this sense, affirming that the cinematic effect of motion is due to the persistence of images in the retina is misleading.

A widely accepted explanation for this effect is that the visual system builds dynamic, integrated perceptions across images, creating the illusion of smooth, continuous motion. This phenomenon, known as *phi motion*, was first described by Max Wertheimer in 1912, one of the founders of Gestalt psychology. His experiments showed that when two lights are flashed in succession with a brief interval, observers perceive movement between them instead of seeing two separate lights. Wertheimer identified a critical timing window for optimal motion perception by varying the interval between flashes. If the intervals are too short, simultaneity is perceived; perception shifts to *phi motion* as they increase. Further increasing the interval results in seeing alternating flashes (no motion). The *phi* phenomenon is a classic example of Gestalt principles at work, illustrating how our perception, in an active and dynamic process, organizes these stimuli into meaningful patterns and not merely receives them passively. Without this process, known as *perceptual binding*, our visual experiences would be fragmented and meaningless.

The mechanisms underlying *perceptual binding* have been intensely investigated in recent decades. Two main hypotheses have emerged as possible neural mechanisms: neuronal synchronization and enhancement of neural activity (firing rates). According to the neuronal synchronization hypothesis, neurons do not function in isolation but interact dynamically, forming large assemblies of active cells. These interactions are mediated by phase coherence in oscillatory signals of specific frequencies (i.e., 40 Hz), resembling an orchestra (Singer, 2018). These rhythms act as perceptual glue, integrating form, color, and texture into a cohesive unit, like violins, basses, and clarinets combine to create a melody. However, this hypothesis remains controversial. Several research groups argue that *perceptual binding* results solely from increased neuronal activity without the need for oscillation-based mechanisms (Roelfsema, 2023).

The focus of attention

When considering cinema's implications for understanding perception, it is essential to recognize that film is more than just recording images. Films tell a story. The camera serves a purpose, with its goal-oriented vantage point based on what the filmmaker wants to convey. A key element in this process is guiding the spectator's attention, usually meticulously planned through storyboards.

Films incorporate various aspects of attentional processes in their cinematographic expressions. One such approach is the art of sculpting a scene, spotlighting characters or objects while blending other elements into the background. This effect is also achieved through the use of a shallow depth of field, which blurs everything out of focus - a technique that has become a hallmark of cinematic style. These methods mirror a fundamental aspect of attention: the process of selecting objects in space, known as *spatial selective attention*. This cognitive ability allows for prioritizing information flow in the brain, which, like any informational machine, has limited transmission bandwidth. By focusing on relevant information, attention ensures that less important objects are erased from conscious experience, thus enhancing the representational capability of the system.

Another powerful cinematographic technique for storytelling,

explored since Vertov's experimental cinema, is the *close-up*, which involves showing full-screen details of a scene. Like lighting and focusing, the *close-up* emulates another aspect of attention by bringing saliency to selected objects when directed at them. This type of *object-based attention* plays an essential role in segmenting the image by actively binding the various features that constitute the object. From a neuroscientific perspective, understanding the neural correlates of attention involves exploring various models that describe how the brain modulates neural activity to enhance the processing of relevant stimuli. While several models have been proposed, recent monkey studies have uncovered a sophisticated mechanism for feature grouping closely tied to attention (Roelfsema, 2023). When visually inspecting an object, it is hypothesized that the brain recruits a so-called *growth cone* of enhanced neural activity. This activity rapidly spreads over time, progressively encompassing the entire object representation. This dynamic process ensures that all relevant features of the object are integrated and processed cohesively, enhancing the brain's ability to recognize and interact with the object efficiently. This mechanism involves the coordinated activity of neural networks, dynamic interactions between neurons, and the integration of top-down and bottom-up processes (Singer, 2021).

Once again, we are reminded of the multitude of intricate processes that unfold in the mind of a spectator immersed in a film. Reflecting on the scene from *Amarcord* described earlier, it becomes clear that Fellini possesses an intuitive understanding of how to engage our brain cells, simulating an attentional gaze-shifting response with extraordinary precision. He demonstrates that a simple, brisk camera movement can be just as impactful. Norman McLaren provocatively suggests that the essence of a film does not reside in the frame itself but in the interplay between them. In our laboratories, vision has been increasingly viewed as a process intricately tied to context, integrating attention and emotion with other sensory modalities. For a neuroscientist, cinema challenges the notion that reality is a simple representation. Instead, it reveals how reality is dynamically constructed, emerging from our interactions with the world in a continuous enactment process. The film, in essence, unfolds not on the screen but inside our heads.

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MUSIC AND PSYCHEDELIC DRUGS AS TOOLS TO EXPLORE CREATIVITY

Frederick Barrett [*]

Abstract

Musical improvisation is an enduring art with a rich history of creative output and provides a model for the study of the neuroscience of creativity. Anecdotal evidence and some recent empirical evidences have suggested that psychedelic drugs may be powerful modulators (possibly enhancers) of creativity. We will explore evidence for psychedelic alteration of creativity and propose an approach to combined use of music and psychedelics as tools for the investigation of the neural basis of creativity.

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THE CREATIVITY CODE

Marcus du Sautoy [*]

Can AI be creative? Most people would reply a passionate "no". The passion comes from the belief that creativity is something uniquely human. The AI revolution we are witnessing is revealing how many things AI can do. There is a feeling that many of our jobs are under threat from the onslaught. Our creativity feels for many like the last bastion of hope for humanity.

The idea of code being creative has a long history. Indeed the person we credit today with being the first coder, Ada Lovelace, contemplated the idea of machines making their own music. Her mother was keen to expose the young Ada to the scientific innovations of the day and on one occasion she took her daughter to see Charles Babbage's Analytic Engine. This was a machine that was meant to use automation to replace the need for humans to do tedious computations like multiplication or long division.

But when Ada saw the machine she saw the potential to make it do more interesting things. The notes she wrote about how to instruct the machine to go beyond computation we now celebrate as the first example of computer code. In those notes are the first hint of the idea of machines being creative. She wrote:

"It might act upon other things besides number...supposing, for instance, that the fundamental relations of pitched sounds in the science of harmony and of musical composition were susceptible of such expression and adaptations, the engine might compose elaborate and scientific pieces of music of any degree of complexity or extent."

But she had a word of caution for those who might get carried away by the prospect of a machine Mozart:

"It is desirable to guard against the possibility of exaggerated ideas that might arise as to the powers of the Analytical Engine. The Analytical Machine

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has no pretensions whatever to originate anything. It can do whatever we order it to perform."

The human is writing the code. The machine is just implementing the code at a speed and depth that perhaps can't be matched by the human but the output should still be credited to the clever human who wrote the original instructions. This idea of the human's being in control of the code has prevailed till very recently. Anything produced by code written in this top down manner should be regarded as the creativity of the person who wrote the code, not the machine.

Machines that learn

But in the last decade there has been a phase change in the way code is being written. Instead of code being written from the top down, this new style of code is written from the bottom up. The idea of code created by machine learning is that code is first written by a human to perform a task, for instance vision recognition, but then as the code interacts with data it has the ability to rewrite itself, to update the code, every time for example the code fails in its task. It learns from its mistakes and then reparametrizes itself with each new interaction with data so that next time it would get the answer right.

This is why our data rich age has been one of the catalysts for the success of this idea of code learning and mutating. The more data it interacts with the better it learns. Now we have the chance for something interesting to emerge from the code that perhaps goes beyond what the original human coder had put in. Because the code is mutating and changing, becoming ever more complex with each interaction, there is the chance for a surprise to emerge from its learning process. And surprise is often one of the criteria for those trying to define creativity.

The classic definition that many resort to for defining creativity is the one proposed by Margaret Boden. Something is creative if it is new, surprising and has value. Novelty is something that we can objectively identify but surprise and value are much more subjective qualities. The fascinating thing is that a machine learning process can start to learn what we humans find surprising and valuable. For example in visual art, we can provide it with two data sets: one of paintings that we value, one

of paintings that are not considered valuable by society. The machine learning process will start to identify traits or patterns in the data so that it too can identify what we humans value, and in turn produce new work that might qualify as valuable.

I think for years I was in the camp that believed that even if you allowed code to learn that how could it really go beyond the limits of what we were giving it, to produce something truly innovative, a new perspective, something creative. But the event that changed my mind to the potential of this new technology to change the game was the story of how a piece of code, AlphaGo, beat Lee Sedol, the best human player, at the game of Go.

Game changer

For me if you were to mark the singularity moment when it comes to AI creativity then move 37 in Game 2 of AlphaGo's titanic battle with Go champion Lee Sedol in March 2016 comes close. Lee Sedol had already lost the first game to the algorithm created by DeepMind but commentators felt that Sedol had perhaps lost by trying to play an unconventional strategy in an attempt to disrupt AlphaGo's dependence on learning from previous games. But in Game 2 it was AlphaGo who broke the rule book of conventional strategy with devastating consequences.

Having made his move, the 36th of the game, Lee Sedol had retired for a quick cigarette break. Not requiring the same external stimulants for its ideas, AlphaGo thought for a while and then asked its human representative to place a black stone on the line five steps in from the edge of the board. Everyone was shocked. Surely AlphaGo had made a mistake. The conventional wisdom is that during the early part of the game you play stones on the outer four lines. The third line builds up short-term territory strength on the edge of the board while playing on the fourth line contributes to your strength later in the game as you move into the centre of the board.

When Sedol returned and contemplated the board, you could see him physically flinch as he took in the move AlphaGo had made. He was certainly as shocked as everyone else by the move. But as the game played out, rather than being a mistake, that stone turned out to be the key to

establishing control of the later part of the game. There had been two previous revolutions in the way Go has been played: one in the sixteenth century and one at the beginning of the twentieth century. AlphaGo's discovery of the power of playing on the fifth line has taught the world a new way to play an ancient game. Analysis since the match has resulted in new tactics played by human competitors. The fifth line is now played early on, as we have come to understand that it can have big implications for the endgame.

For me move 37 of game two passes those three tests that Boden identified if you are going to call something creative: novelty, surprise and value. In the case of Move 37, it was a new move, it certainly surprised the Go experts. This was a move that broke years of conventional strategy. And ultimately it had value because it won the game for AlphaGo.

What is important about the AlphaGo story is that it demonstrates the powerful role that AI can play not so much in making machines like creative humans but more as a powerful tool to stop humans behaving like machines. We can get terribly stuck in certain ways of thinking that limit our creative output. As a Go player your master would have previously slapped your wrists if you placed a stone on the fifth line so early in the game. But the algorithms exploration of the terrain can reveal sometimes that humans have got stuck on a local maximum thinking it the pinnacle only to discover that we are only on the top of Snowdon and there is an Everest waiting across the valley to climb to even greater heights.

A game is an easier place to determine value because you either win or lose. One of the challenges of artistic creativity when it comes to AI is that computer science is highly focused on the idea of problem solving. But creating art is not a problem-solving activity. So can this creativity in a game translate into AI creating something of artistic value in the visual arts, literature or, as Ada Lovelace challenged, in music?

Going beyond pastiche

Part of that feeling that AI can't be creative in these realms comes from the common held belief that given that machine learning works by giving it data, whether musical compositions, visual art, poetry or literature, that how can it achieve anything other than more of the same.

That the best we can expect is pastiche or very good copies.

Certainly a lot of the early examples of generative AI had that feel to it. The Next Rembrandt project for example did an amazing job of taking all the portraits that Rembrandt had painted as training data and got an algorithm to produce a new portrait that looks remarkably like a Rembrandt. In experiments that I have conducted where I offer audiences a choice between the AI Rembrandt and a genuine Rembrandt, there is generally a 50:50 split in people trying to identify the fake. What is interesting is that they can immediately recognise the artist behind the paintings. Rembrandt's style is sufficiently unique that people can quickly name the artist. And it is this unique style that the AI is identifying in the training data.

In my Rembrandt-Turing test I must admit that I may be biasing the experiment by having chosen a rather lesser known genuine Rembrandt with which to challenge audiences. I needed something that people didn't know already. But by virtue of it being lesser known, it is also not a very good Rembrandt which might be throwing people.

Many people's early experiments with visual generative AI involved creating images in the style of a famous artist. Take a selfie and put it through one of these algorithms and you've got your portrait painted in the style of van Gogh or Renoir. But none of these are generating anything we would call creative. It is reenforcing the idea that the best AI can do is pastiche.

But being exposed to data from the past does not mean an AI has to be boxed in by these constraints and be doomed to replicating past successes. After all human creativity itself depends on being emersed in the art of the past before it breaks out into the new. Picasso learned to replicate style before he went on to break it. And it is that word "break" that is key to why and how AI too can be creative based on training on the art of the past.

For me Generative Adversarial Networks or GANs have been some of the most successful algorithms in generating new art. These algorithms are really two algorithms, the discriminator and the generator, working in a game against each other. The first algorithm is given the art of the last two thousand years and learns about style. It is able to take an image it hasn't seen before in its training data and classify it according to style: this

painting is cubist, this pointillist. It becomes a very good art historian. This is the discriminator algorithm.

The generator algorithm is now tasked to create an image that breaks style. It has to move outside of the parameter set that it has learnt from. To create something new. Its attempt is then fed back to the discriminator algorithm who either rejects it for being too close to existing style or too far from anything that might be regarded as acceptable visual art. In some sense it is trying to find the sweet spot on something called the Wundt curve which models hedonic value against arousal potential.

If we get too habituated to art work around us then this leads to indifference and boredom. This is why artists work never really stabilizes because what arouses both the artist and eventually the viewer is something that moves away from that to which we have become habituated. But the push into the arousal potential must not be so excessive that we hit the negative hedonic region of the Wundt curve. There is a maximum hedonic value that the artist is after according to the Wundt curve. You are after something new but not so new that it elicits a repulsive response.

The visual GANs were some of the first generative algorithms that went beyond pastiche. Another exercise I do is to challenge audiences with four images by modern human artists set alongside four images produced by GANs. When I first started this experiment in the early days of generative AI, I got a similar 50:50 split in audiences identifying the AI art. But after a few years that began to change. What was interesting is that as more people played around with these algorithms themselves they started to recognise a distinctive style that the art generated by a GAN possessed. Increasingly when I do this experiment I get a 10:90 split with audiences successfully identifying the AI art.

I think this is testament to the fact that the GANs are showing that generative AI can go beyond just copying and can make something new. Whether you think it is good or not is another question but it is at least a distinctive style that expresses something about the internal way AI works. It has an interesting complexity and fuzziness about it. Think of the portrait of the fictitious Edmond Belamy signed in the corner by a formula that is part of the algorithm that created the portrait. It has this rather unique AI quality to it. This image was sold by Christie's for a staggering $432,500, surpassing its starting price by a factor of nearly

45 times. The monetary value that the portrait raised at Christie's was partly generated precisely because it is created by an AI rather than some independent assessment of its artistic value. It is the AI version of Duchamp's urinal.

The images I show in my modern art Turing test were all displayed in a gallery at the Basel Art Fair but without telling the visitors that any of the images were generated by non-human artists. The interesting thing is that visitors when quizzed about the art responded by saying they had more of an emotional engagement with the art that turned out to be AI generated. When they were told about the origins of the art, many felt cheated. They wanted their art to connect to the soul and emotions of another human being, not a sequence of 0s and 1s. But I think this misses a crucial point. The AI has been trained on our emotional world. Our visual art represents a window into what it means to be human, our emotions, what we value, how we see. It's no wonder that given this training data that an AI might produce something that similarly reflects our human emotional state.

In some ways I think the new AI visual algorithms like Dall-e and Midjourney have taken a step backwards. They have taken this interesting AI style that was emerging from the generative AI and returned images to ones that are more recognisably human.

Do androids dream of electric sheep?

Some of the most successful AI visual generation algorithms though produce images that are not perhaps interesting from an aesthetic point of view but perhaps for me go to the heart of what we really mean by creativity. Boden's definition of creativity is useful from a functional point of view but perhaps it is Carl Rogers' work on creativity that is more relevant.

Rogers believed that creativity was the tool that we humans produced as our consciousness emerged to help us to understand the mind of the other. As these internal worlds took shape we needed some way to probe both our own emotional states and to explore whether the pain or ecstasy that I was experiencing was anything like yours. Creativity and out artistic output allowed us a tool to project these internal worlds into the language

of words or visuals or music.

The current AI is certainly not conscious but perhaps we might say there is a strange sub-conscious that is emerging. The code that is produced by machine learning is so complex that a line by line analysis is totally inadequate to understand why the code is producing the output it does. Looking at the code is as helpful as trying to understand a human's emotional state by looking at individual neuronal activity. To understand how this new code is working and making its decisions we are going to need new tools. And perhaps by asking the code to be creative we can get some new insights into the workings of the code.

This for example for me is the interesting insights that Google's Deep Dream project provided. It grew out of the huge success machine learning was having at recognizing what was in an image. The ability to recognise an image is a result of the stacked layers of artificial neurons that play a game of 20 questions but here we've got 10-30 layers of neurons asking questions about the image.

The trouble is that as the machine learns and changes the human programmer begins to lose track of what features it regards as key to identifying a banana or a cat. So the programmers had the clever idea of turning the program on its head. They gave the algorithm a random pixelated image and asked it to dial up or enhance the features that it regarded as triggering the recognition of something like a banana. The result would then reveal something of what the algorithm was looking for or detecting at each layer of the neural network.

They were essentially exploiting the way a human can look at an image and suddenly see a face in their toast or an animal in the undergrowth when there is nothing there. The human brain has evolved to be very sensitive to images of animals because that is the key to its survival. But it means that sometimes we see animals or faces where there are none. The algorithms are working in a similar way. They are detecting patterns and interpreting them in the decision tree. They have learnt to detect these patterns in a compressed version of evolution where they have been trained on thousands of images and survival corresponds to correctly identifying the images on new data. Machine learning is basically digital evolution. Survival of the fittest algorithm. So what are the algorithms seeing in the digital undergrowth?

The results were quite striking with starfish and ants appearing from no where. It seems that within the algorithm was the power not just to recognise images but also to generate them. But this wasn't just a fun game. It gave some fascinating insights into how the algorithm had learnt. For example images of dumbbells would always have an arm attached to the dumbbell. It was clear that the algorithm had learnt about dumbbells always from images of people holding the dumbbells. So it hadn't understood that these things weren't an extension of human anatomy and could stand on their own. This process of asking the algorithm to be creative revealed bad learning that had happened or biases that were picked up by the algorithm.

By applying the algorithm over and over on its own outputs and zooming in after each iteration, the programmers could generate an endless stream of new impressions that are beginning to border on something creative emerging out of the algorithm. A genuinely new vision which the programmers believed allowed one to explore the set of things the network knows about.

What perhaps is genuinely exciting about this project is that the art is allowing us to get some glimpse of what it is that the computer vision algorithms are really seeing when they learn to classify images. The machine learning algorithms lead to decision trees that it is very hard for a human to unpick. Sometimes the features that it is detecting and choosing between are things that we recognise but other times it seems hard to name what it is the algorithm is distinguishing in the image. It is giving us an insight into the level of abstraction that the algorithm is working on at particular layers of the decision tree. We are penetrating the deep unconscious of the algorithm. The programmers called the process inceptionism and the outputs DeepDream. Certainly the images that the algorithm is generating have a crazy psychedelic feel to them as if the algorithm is tripping on acid.

I don't think anyone would rank the product of DeepDream as good art (whatever that is). As the Guardian columnist Alex Rayner who first wrote about these images commented: "they look like dorm-room mandalas, or the kind of digital psychedelia you might expect to find on the cover of a Terrence McKenna book". Not things you'll find in Frieze Festival in London or Art Basel. But it still represents an important new

way of understanding something of the internal world of the algorithm as it classifies images.

The advent of machine learning as a way to write code has been a game changer giving rise to the potential for AI to be creative in its own right. Going forward the creativity of machines will possibly be the only way we will be able to recognise another potential phase change in AI. That is the question of whether AI might ever become conscious. I don't see any a priori reason why this can't happen but being able to tell is going to be very difficult. In fact it goes to the heart of why the hard problem of consciousness is so hard. How can we tell if anyone other than ourselves has a similar internal world to ours.

One word that currently distinguishes human creativity from AI creativity in my view is *intention*. AlphaGo did not want to play Go, it had no agency in its engagement, no intention. Similarly with the art that generative AI is spewing out. But if AI ever becomes conscious then that intention will emerge. It will be desperate to tell us about this phase change. It is then that its creativity will become an agent for telling us about this new inner world. It will want to write its novel, compose music, paint canvases in a desperate bid to convince us that there is a ghost in the machine.

Humans are built in a similar manner to each other so it is fair to believe that our consciousnesses are similar. But if machines become conscious it is likely to be a very different entity. As Wittgenstein said: if lions could talk then we probably wouldn't be able to understand them. If machines become conscious then that consciousness will be very different from our own. As Carl Rogers proposed it will be the creativity of the machine that will be the best tool for humans to understand what it might feel like to be a bit of conscious AI.

To find out more about AI creativity check out my book The Creativity Code (Fourth Estate, 2019).

CREATIVITY IN CONTEXT: THE BIG PICTURE

Edward Kelly [*]

Let me begin by thanking Dr. Portela and the program committee for giving me this opportunity to speak to you about the further reaches of creativity theory and research. Thanks also to Stefan Schmidt for his generous introduction.

I'm acutely aware that for many of you who are involved in mainstream research, certain parts of what I have to say will likely take you outside your normal comfort zones. I certainly don't expect to carry all of you with me all the way, but I do hope to persuade at least some of you - especially some of our younger members and other potential new recruits - to take my message more seriously than you might otherwise have. You see, I'm one of a still quite small but growing number of people who think that we are at or very near a major inflection point in modern intellectual history, in which the science-based worldview known as physicalism - which dominates most current mainstream science, which has destructively colonized the humanities generally, and which constitutes the received wisdom of opinion elites worldwide - is undergoing a tectonic shift at its very foundation. In a nutshell, the founders of modern science deliberately excluded mind and consciousness from their research concerns, and although that exclusion certainly facilitated the extraordinary theoretical and practical scientific achievements of the next several centuries, what began as a helpful methodological principle had metastasized by the end of the 19th century into a pernicious metaphysical doctrine that among other things has proven incapable of accommodating what had been excluded at the outset - the core phenomena of mind and consciousness. What I want to accomplish in this talk is first, to explain what has led me to abandon the prevailing physicalism; second, to sketch the contours of an alternative science-based conceptual framework or worldview that

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seems now to be gaining strength; and third, to situate the developing science of creativity within that expanded framework.

I must begin by acknowledging that I am not a professional creativity researcher. On the other hand I'm not a complete stranger to the subject either. My first experience of serious scholarly endeavor in fact came during my final year in college, when I was admitted into a special program that allowed fifteen of us seniors to work full-time on approved projects of our own choosing, with no required coursework or other academic responsibilities of any kind.[1] My project was to survey existing literature on the creative process and creative personality structure, with a view toward formulating a possible plan for further research in graduate school. To that end I read widely and diligently, ultimately generating a final report that was roughly on the scale of a Master's thesis, some 145 pages in length.

There were four main takeaways for me from that protracted effort, and I will briefly summarize them here inasmuch as they still seem relevant today. First, the overall state of the science of creativity at the time was pretty dismal. The psychometrician J. P. Guilford had recently given a presidential address to the APA in which he lamented the dearth of serious research on a subject that he thought should be at or near the center of our professional interests in view of its enormous human importance. Only a tiny fraction of all publications in the APA system of journals, something like .1-.2%, had been directed to studies of creativity, and Guilford was openly dismayed by that lack of effort. Although his very public complaint provoked a modest increase in creativity research at the time, I think we can all agree that this vital field of study has remained conspicuously undernourished in terms of human and financial resources right down to the present day.

A second takeaway was that two sharply contrasting strategies dominated the existing approaches to creativity research. One sought to approach the subject incrementally from below, so to speak, by studying low-level forms of creativity such as puzzle-solving and word-association tasks, mostly in convenience samples of psychology undergraduates. The other, to which I was much more strongly drawn, focused primarily

[1] This was the "Scholar of the House" program at Yale University.

on indisputable historical examples of genius-level creativity in poetry, literature, plastic arts, architecture, music, mathematics, science or whatever, and sought to learn whatever we could about those people and their creative work by studying autobiographies and/or biographies, accounts of particularly creative episodes or periods in their lives, and so on. A third and intermediate sort of strategy had recently been initiated through Berkeley's Institute for Personality Assessment and Research (IPAR) by people such as Frank Barron and Donald MacKinnon, one which I also found promising: Specifically, their approach was to identify *living* persons who were prominent in various creative endeavors and to invite them to IPAR for extensive structured interviews, coupled with personality and cognitive-style assessments using standardized psychological self-report instruments and the like.

My third takeaway was that work of the latter two kinds had already led to a considerable degree of consensus regarding the basic psychological characteristics of the creative process. This is summarized descriptively in the classic four-stage model (preparation, incubation, inspiration, and verification), which I first encountered in literary critic Brewster Ghiselin's excellent introduction to his 1952 collection of historical cases, but which can be traced back to earlier sources such as psychologist Eliot Dole Hutchinson, political scientist Graham Wallas, and the great 19th century physicist and physiologist Hermann von Helmholtz. In brief, the *preparation* phase consists of intense conscious effort on the particular task or problem at hand. If that preliminary effort fails, and the problem is set aside in frustration, an *incubation* period of variable length follows, during which additional work of some largely unknown sort appears to continue at some other level(s) of the personality. Then in the most interesting cases comes an *inspiration* phase, in which the results of this underground work are delivered in some form to waking consciousness. The subsequent *verification* phase consists of evaluating and perhaps elaborating the newly received material and integrating it with whatever had been accomplished previously. As shown clearly by Ghiselin and others, a descriptive model of this sort often applies not only globally, successfully characterizing many striking examples of creative activity as a whole, but to subordinate elements or moments nested within them. What I found most interesting and theoretically challenging, however,

was the character of what emerges in the inspiration phase, which is often very unusual in respects such as its complexity, precision and speed. It's also very often pictorial or symbolic in character rather than propositional, even in areas such as literature and mathematics, and sometimes accompanied by extremely intense affect. The only people who were really trying to deal with such features systematically at that time were the psychoanalysts, with their conception of a "primary process" form of mentation that underlies dreams, psychosis and creativity (in contrast with the "secondary process" of normal everyday propositional thought), but they were already losing traction within academic psychology. As I'll explain more fully later on, these aspects of creative mentation remain deeply problematic for cognitive science even now.

The four-stage model of the creative process seemed to me descriptively the best available, and it also harbored definite implications for our conception of creative personality structure. The unusual forms of mentation that emerge during episodes of creative inspiration can sometimes be very disturbing psychologically, and consequently invite interpretation as expressions of some sort underlying psychopathology. Interest in possible connections between mental illness and creativity goes at least as far back as Plato's *Phaedrus* and had grown particularly strong during the late 19th century, with the advent of so-called degeneracy theorists such as Nisbet, Nordau and Lombroso who essentially equated the two. Examples of apparently mad genius were easily found, but some of the psychoanalysts recognized early on that even in persons in whom overt pathology was obviously present, something more was required to provide a full picture of their creative accomplishments. The manic phase of bipolar disorder, for example, can definitely contribute to creative work by providing useful raw materials, but the creative personality has to be strong enough to withstand the psychological dangers associated with the unusual mentation flowing in. This basic insight, enshrined in Ernst Kris's doctrine of regression in service of the ego, was subsequently elaborated and confirmed empirically by the work of Frank Barron and the IPAR group, and this constituted the fourth takeaway from my project.

That's about where I left the subject at the time of graduation from college. I then took the following year off, mostly drifting around aimlessly in France and Morocco while struggling to figure out what to

do next with my life. Early in 1963, in Paris, I read a series of newspaper articles about Timothy Leary and Richard Alpert, psychologists who were doing what sounded like some really interesting work involving psychedelics at Harvard. Excited by that news I took the GREs, applied for admission to graduate school there, got accepted into what was then called the Department of Social Relations, and headed home. On the way back to the States, on a cheap but slow "student ship" loaded with persons much like myself, I was fortunate to encounter some very good hashish that made a powerful and permanent impression deeply relevant to the subject of creativity: Specifically, over the course of several hours lying alone in my semi-darkened bunk, I was forced to recognize that something within me, the existence of which I had never before suspected, was capable of generating immense worlds of experience that seemed at times at least as real as everyday experience itself. This amplified further my interest in working with Leary and Alpert, but alas by the time I arrived in Cambridge in August of 1963 they had already been fired for supplying psychedelics to undergraduates, and had moved elsewhere. I allied myself instead with the psycholinguistics and cognitive science wing of my department, and began working toward the Ph.D.

This was an exciting time in mainstream American psychology. The dark ages of Watson's radical behaviorism were finally waning, partly in response to Noam Chomsky's destructive review of B. F. Skinner's masterwork *Verbal Behavior*, and a much richer and more promising alternative - the computational theory of the mind (CTM) - was on the rise. General-purpose computers were rapidly improving, and they had been shown equivalent to universal Turing machines which could in principle compute anything computable. The brain could be understood as providing hardware for the mind, which could be modeled in software. Newell, Shaw and Simon had already begun developing their General Problem Solver and were making very strong claims about the long-term prospects for success. Marvin Minsky, leader of the influential artificial intelligence group across town at MIT, was talking about how in just a few years our computers were going to be so smart that we'd be lucky if they kept us around as household pets. The excitement was palpable and contagious, and I bought into it at first without reservation.

Now, this new science of the mind, like pretty much everything else

going on at the time (and today as well), was developing in the context of the science-based picture of reality known as physicalism that arose over the past several centuries in conjunction with the evolution of science, and here I must elaborate a bit regarding that currently dominant worldview. The physicalism I'm talking about is essentially a philosophically austere modern descendant of the "materialism" of previous centuries. It comes in a variety of subtly different flavors, but the underlying core ideas are really quite simple: Space and time exist absolutely, providing a pre-existing container for everything that happens. The world we experience consists at bottom of tiny bits of some sort of solid, insentient, self-existent material "stuff" moving around in accordance with mathematical laws under the influence of fields of force, and everything else that happens including our human minds and consciousness necessarily emerges somehow from that basic stuff. We are nothing more than immensely complicated biological machines, operating deterministically, so our everyday experience of ourselves as purposive agents equipped with free will is a delusion. Similarly, since mind and consciousness are entirely the products of physiological processes occurring in our brains, there is no possibility whatsoever of any form of post-mortem survival. On a more cosmic scale we see no sign of final causes or any sort of transcendent order; on the contrary, the overall scheme of nature appears in the end to be utterly devoid of meaning or purpose. As physics Nobel laureate Steven Weinberg famously put it, the more we learn about the universe the more it all seems pointless.

This bleak and arguably destructive worldview is of course the basic story that most of us have grown up with from the time we were kids in elementary school. It is also the story that most educated people today, including most mainstream scientists working in areas such as biology, neuroscience, psychology, and the social sciences, still take for granted (at least in their day jobs), as the proper scientific picture of the natural world. It's firmly anchored to the classical physics of the late 19th century, of course, and a lot has happened in physics since then. All professional physicists know it's wrong in fundamental respects, and enormous efforts are currently underway in attempts to reconcile relativity and quantum theories, our two most fundamental physical theories. But for most of us that ongoing discussion involves things too remote from everyday

experience - too big, too slow, too small, too fast - to command our attention, even if we have the technical skills needed to follow it.

That was certainly the case for me as a beginning graduate student in psychology, and for most if not all of my fellow students as well. We were probably all physicalists of some sort - not explicitly so, as the result of reasoned discussion, but implicitly, by virtue of passively absorbing what was just part of the intellectual atmosphere of the time. We were all fish living in that water, as it were, passively absorbing its contents as if by osmosis. Physicalism itself was unquestioned, and indeed initially seemed to me unquestionable. Late in graduate school, however, two things happened that began to undermine my allegiance.

The first arose in connection with my dissertation research. I was working with a group doing computer-aided content analysis, and it had become clear that considerable improvements would result if our computers could be enabled to recognize major senses of high-frequency words in context. For the word "like", for example, it is clearly desirable to distinguish its use as a verb, connoting positive regard for its object, from its uses as a preposition, or worse yet as a space-filler in casual conversation - like, uh, you know, whatever. To improve that situation we initiated a project which was dauntingly massive for that time, although it would be kid stuff now. It turns out that about 90% of all the individual words or "tokens" in an average running text derive from something like a mere 2,000 dictionary entries, or "types". Our plan was to identify such words in English and develop dictionary entries for them consisting of routines that would enable the computer to scan the current context and take a decision as to which of the possible senses was occurring. To accomplish this, we first created a 500,000 word sample of typical content-analysis texts, and then generated a "concordance" for the entire sample. In the concordance, which we printed out in a set of binders that nearly filled a small office in William James Hall, all occurrences of each dictionary entry appeared together, each centered in the printout with perhaps 10-15 words of context on either side. This constituted the raw data for the main project. From the concordance, which for the entries of interest provided hundreds or sometimes thousands of examples of their use by ordinarily fluent speakers for ordinary purposes, a sizeable team of undergraduate and graduate students including me attempted

to construct simple rules permitting reliable identification of major word senses in their typical contexts of occurrence. I should emphasize here that this concordance itself provided us with an experience that few if any other linguists or psychologists have ever had.

The project went on for years and was moderately successful from a practical point of view, enabling a modest reduction of lexical ambiguity and corresponding improvement in the power of our content-analysis system, but for me the main import was to reveal that ideas then widely circulating as to how disambiguation works in humans were profoundly incorrect. The central such idea, arising out of Chomsky's work on transformational grammars, was that the meanings of words are finite in number and fixed in advance, and that disambiguation consists simply of selecting which of those pre-specified meanings is the one actually present in the given context. Our project embodied that strategy, albeit in a primitive form, and what our very unusual database soon taught us was that what actually goes on with typical high frequency words such as *go, make, take, run*, and *line* is something utterly different. Dictionaries list large numbers of "senses" for such entries, more or less in proportion to the size of the dictionary, but it became clear that such words really involve much smaller numbers of much more general meanings. Fluent speakers of the language consciously understand those meanings, and as a result they are able to deploy the words into an unlimited variety of novel but semantically appropriate contexts - including in the limit metaphorical contexts. I became convinced, and remain so, that no computer system built on current principles can distinguish metaphorical truth from literal falsehood.[2]

These discoveries about the unsuspected complexities of word

[2] These matters are discussed at length in chapter 4 of Kelly & Stone (1975), based on my dissertation. I did not speak in that chapter about the conscious grasping of meanings, because at that time the word "consciousness" was not spoken in polite scientific company, but that's what I had in mind. Let me also add parenthetically here that unlike my "Edges of Creativity" co-panelist Marcus Du Sautoy and numerous others I do not believe that we are anywhere close to artificial *general* intelligence, and that the primary reason for this lies in the necessary absence of such conscious grasping of meanings in the currently available technology. AI "hallucinations" are inevitable, and if the products of AI are added to the data used to train it, the stage is set for progressive degradation of our civilization's collective information space. See also the forthcoming book *Irreducible* by microelectronics pioneer Federico Faggin.

meaning came as a serious shock to me at the time. I was close to the end of my dissertation process and starting to think about employment, but I had become profoundly discouraged with regard to my own prospects for useful further work on the CTM. Then came the second of the two events alluded to above: Specifically, as a result of some personal experiences involving my only sibling, an older sister, I came into initial contact with the literature of experimental parapsychology. Right there in Harvard's Widener Library I discovered that the same sorts of experimental and statistical procedures that we routinely apply to all sorts of conventional topics in psychology were also being used systematically to study things that according to the physicalist worldview should not be possible, and yet those things actually appeared to occur.

I'm sure that many of you are unfamiliar with this subject, so let me expand a bit here. There are two main classes of phenomena, collectively designated by the generic theory-neutral term "psi", in which information seems to flow between an organism and its environment despite the presence of some sort of *barrier* that on ordinary physical principles should be sufficient to prevent them from occurring. On the input or extrasensory perception (ESP) side, for example, subjects may succeed to a statistically significant degree at identifying randomly selected targets that are sealed in black envelopes, or located elsewhere, or not even chosen until a later time. Similarly, on the output or psychokinesis (PK) side, evidence has accumulated that some people are able to influence various kinds of physical events in their environments without using the normal motor systems or technical extensions of these. I found all this more interesting than alarming or threatening, precisely because of its potential theoretical implications, and after some back and forth correspondence with J. B. Rhine took an entry-level position at his laboratory in Durham NC, which at the time was still the center of American experimental parapsychology. Shortly after starting there I had the good fortune to meet an individual who is without doubt one of the most gifted performers ever to appear in a parapsychology laboratory. This individual, who at the time was a student at Yale Law School, could do virtually anything we asked him to do, often to extreme levels of statistical significance, and he quickly erased any residual doubts that I still entertained as to the reality of the basic psi phenomena.

Let me go on here to state quite baldly my own informed and considered opinion as to the net status of this kind of research. Serious scientific work has now been going on for something over 150 years, starting even before the formation of the British Society for Psychical Research (SPR) in 1882, and the accumulated evidence from large numbers of case and field studies, plus something like a couple of thousand experimental studies, seems to me more than sufficient to convince any reasonably open-minded person who takes the trouble to study it in some detail that these anomalous phenomena really do exist as facts of nature, and that our scientific worldview *must* therefore expand in some way in order to accommodate them.

I worked at the Rhine lab for about 18 months, but then moved across town to the Electrical Engineering Department at Duke in order to pursue a more psychobiological approach to the study of psi based on EEG neuroimaging studies with exceptional performers. We made slow but encouraging progress in that direction over the next 15 years, despite severe and chronic shortages of funding and staff, but eventually ran out of cash altogether. Following a brief but harrowing period of unemployment I then took a position with a large somatosensory neuroscience group at UNC-Chapel Hill, where for the next 14 years I carried out EEG and fMRI neuroimaging studies of human cortical responses to natural tactile stimuli such as mechanical flutter stimuli applied to individual fingers. This work certainly had its subtle joys, and we discovered some truly remarkable things, but I was constantly on the lookout for an opportunity to get back into psychical research.[3]

That opportunity arrived in 1998 in the form of two interconnected events. In June Emily Williams and I married, following a courtship of some six years. Ours was a commuting relationship, because Emily was a long-time colleague of UVA psychiatrist and psychical researcher Ian Stevenson, who had founded DOPS in 1967 and who was the principal

[3] My enthusiasm for psychobiological studies of psi has continued undiminished to this day, and I am pleased to report that much of my own work at the University of Virginia has gone into creation of a neuroimaging laboratory facility that we could only dream about back in the Duke period. We invite contact both from persons with psi abilities and from research professionals with strong neuroimaging skills. Extensive information about DOPS in general and the lab in particular can be found on our website, which you can access simply by googling "DOPS UVA".

architect of an important new line of research involving children who appear to remember events from a previous life (we call these "cases of the reincarnation type" or CORT). Later that summer we were both invited by Michael Murphy, whom you may recognize as the co- founder of Esalen Institute in Big Sur, California, to participate in a new fellowship that he was creating, under the umbrella of Esalen's Center for Theory and Research (CTR), the initial purpose of which was specifically to examine the existing empirical evidence for postmortem survival. This may come as a surprise to many of you, but there have been many decades of serious scientific work on this subject, including not only Ian Stevenson's CORT research but work going back to William James and his SPR colleagues on related topics such as trance mediumship and crisis apparitions. Mike Murphy, parenthetically, is a modern-day renaissance man in the direct line of descent from the founders of the SPR. He understood perfectly that postmortem survival is a watershed issue theoretically, because if physicalism is true then nothing of the sort is possible, period. Yet he also knew that a few dedicated researchers scattered around the globe have produced, and are continuing to produce, various kinds of evidence indicating that it does in fact at least sometimes occur.[4]

The main vehicle for CTR fellowships consists of annual week-long meetings in the spectacular physical environment of Esalen, perched on a cliff overlooking the Pacific Ocean. Some 20 of us gathered for that first meeting in 1998, and we commenced our discussion of the survival literature. By the end of our second meeting the following year, it had become clear that although we held somewhat differing views on the survival issue itself, we were unanimous in believing that the prevailing physicalism rests upon an insufficiently inclusive empirical foundation and needs to be reworked at a fundamental level. Accordingly, we formulated a two-stage plan of attack that ultimately went on for over 20

[4] Ironically, the main threat to the survival interpretation of this evidence is the demonstrated existence of psi! Specifically, in the absence of reliable knowledge of the *limits* of psi it can become extremely difficult to rule out the possibility that ostensible evidence for survival is explainable instead in terms of psi interactions involving only living persons (this is the "Living Agent Psi" or LAP hypothesis). At least some of the ostensible survival evidence undoubtedly *can* be explained in that way, and there remains at present within the field of psychical research a deep divide, with more or less equally able and informed persons on both sides, between those who do and those who do not accept the reality of survival.

years and resulted in three large books (Kelly et al., 2007; Kelly, Crabtree & Marshall, 2015; Kelly & Marshall, 2021). What I want to do next, without getting too far into the weeds, is to give you an overall sense of what we did and what I think we accomplished, together with its implications for the science of creativity.

The central goal of the first phase was to assemble in one place a large amount of empirical evidence for human psychophysical capacities that clearly defy, or at least strongly resist, explanation in conventional physicalist terms. Here I should provide a little of the implicit philosophical background. What is ultimately at stake here is the nature of the relationship between brain and mind. Now, everybody agrees that close connections normally hold between physical events in the brain and resulting mental events. We all know, for example, that if we get hit hard enough in the head, drink too much, ingest a psychedelic, or perhaps grow a brain tumor, mental things will change. There can be no doubt about the reality of what looks like physical-to-mental causation. But what about causation in the opposite direction? Suppose for example I decide to raise my arm with the intention of asking a question, and the damn thing goes up in the air; isn't that an example of mental-to-physical causation? The conventional physicalist answer to such a question is "No; you've misunderstood the causality here, you see, because your experience of an intention to move your arm was really nothing more than a physical process going on in your brain, and that physical process is what actually caused your arm to move. Physical causes physical, no problem."

That sort of argument is difficult to refute under everyday circumstances such as raising an arm, but it can be circumvented by identifying empirically validated psychophysical phenomena that cannot plausibly be accomplished by the unaided brain. That's precisely what we set out to do for the first book, taking as our model or template the extraordinary two-volume work published in 1903 by Frederic Myers, a colleague and friend of William James and one of the founders of the SPR. We essentially revisited, in light of the subsequent century of biomedical research, many of the topics that Myers himself had studied and written about, including genius.

First on any list of relevant phenomena of course is psi itself. The conflict with physicalism is especially clear and blatant in this arena, and

that undoubtedly accounts for the extraordinary hostility the subject sometimes provokes in persons for whom physicalist ideology amounts to a secular faith. My co-authors all shared my own positive attitude toward the subject as stated above, and we all wanted to include it in the book, but at the same time we did not want ours to be a book mainly or even in substantial part about parapsychology. Instead, we incorporated the entire literature of psychical research by reference and included an annotated bibliography providing pointers to what we view as especially significant parts of that enormous literature.

Many mainstream scientists would undoubtedly like to think that psi is a unique anomaly that can be set aside or quarantined and safely ignored, but that is emphatically not the case, and *Irreducible Mind* (henceforth *IM*) goes on to examine in detail a number of others. For starters, Emily produced a comprehensive survey of the literature on *psychophysical influence*, proceeding in a Myers-like way from very ordinary forms to more extreme kinds for which the possibility of physicalist explanation becomes increasingly unlikely. The latter include, for example, cases involving *stigmata*, in which devout Christians with vivid imaginations develop wounds corresponding to those inflicted upon Christ himself during his crucifixion. There are hundreds of such cases in the literature. A psychologically related phenomenon is that of hypnotically induced blisters of pre-specified shape: Pierre Janet, for example, reported cases in which he touched deeply hypnotized persons with a cool star-shaped pointer that he told them was red-hot, and observed the rapid formation of correspondingly shaped blisters. Extreme levels of pain control were also reported during the pre-anesthesia era by the British physician James Esdaile, who carried out hundreds of major surgeries in India using only hypnosis. Many additional examples of these sorts are provided in the chapter.

Next comes a chapter on memory by Alan Gauld, who has spent a lifetime studying that difficult subject. Much of Alan's discussion deals with properties that human memory shares with consciousness more generally, and he both echoes and reinforces anti-physicalist arguments appearing in recent discussions of consciousness among philosophers of mind. He also identifies a variety of empirical and conceptual problems in mainstream memory research, and sketches the evidence for, and

implications of, postmortem memory formation and recall.

Clinical psychologist, historian of psychology and philosopher Adam Crabtree next surveys the enormous literature on psychological automatisms and secondary centers of consciousness. The crucial fact is that many well-documented cases have been published in which two or more full-fledged personalities appear to occupy the same organism, and to do so concurrently rather than sequentially. The personalities can differ markedly in character, interests, and knowledge, and even in deep-seated physiological characteristics such as allergies and defects of vision. Normally hidden "alters" or secondary personalities also sometimes greatly surpass the primary or everyday personality in terms of intellectual and creative capacities. Perhaps most interesting and theoretically challenging of all, there is sometimes a peculiar asymmetry of consciousness such that a secondary personality knows what is going on inside the primary personality, but not vice versa.

The next chapter, again led by Emily, focuses mainly on near-death and out-of-body experiences (NDEs and OBEs), providing an overview of their characteristics and the deficiencies of existing attempts to explain them in physicalist terms. Of particular theoretical importance is the large subset of NDEs that occur under extreme circumstances such as deep general anesthesia and/or cardiac arrest. In these cases, physiological conditions regarded by virtually all neuroscientists to be necessary for conscious experience have been seriously degraded or abolished altogether, and yet the patients report not just having had conscious experiences, but having had the most intense and transformative experiences of their entire lives. In the best such cases, moreover, the reports include *time anchors* - verifiable descriptions of nearby or distant events that occurred during the period of apparent unconsciousness. In short, such cases appear to provide direct evidence that conscious experience can occur in the absence of a functioning brain. I emphasize here that these cases are coming straight from the heartland of modern biomedical science. Resuscitation medicine is steadily improving, and we're getting better and better at retrieving people from the borderlands of death. I strongly suspect that in the near term this will prove the single most critical point of contact between psychical research and mainstream neuroscience.

Next comes a chapter on genius by myself and Michael Grosso. I'll

say a little about that here and return to the subject in a larger context shortly. Our chapter closely tracks one with the same title in Myers (1903), a chapter which in my estimation is a work of genius itself. I had never discovered it in the course of my earlier project on creativity, sadly - probably because it appears in a book that's mostly about psychical research - but I can tell you that it anticipates virtually everything that I had found good in the subsequent sixty years of scientific literature on creativity, as described earlier, and then some. For starters, Myers approached the subject from the top, focusing on extreme cases - those gifts "bequeathed to us by the highest minds, as the heritage of their highest hours" - and rejected degeneracy theories. A poet himself by training and temperament, Myers was interested in the apparent automatism of creative inspiration - which he terms "subliminal uprush" - and especially in the unusual or "incommensurable" character of the mentation that emerges. We describe Myers's views in considerable depth in our chapter, and update them in light of a variety of more recent research. One such topic that I'll highlight here, because it connects back specifically to my dissertation experience, concerns the role of *metaphor* in creative activity and in thought more generally. People such as George Lakoff and Douglas Hofstadter have subsequently come to recognize and celebrate the ubiquity and power of analogical thinking, and serious efforts have already been made by cognitive scientists to model it. We review those efforts in our chapter and find them all wanting (including Hofstadter's own), precisely because of the fundamental limitation I noted earlier - the inability to grasp and utilize general meanings. We end the chapter by dwelling in some detail on the astonishing Indian mathematician Ramanujan, who represents a kind of North star by which to judge progress in our understanding of genius. In sum, I sincerely hope that at least some of the creativity researchers in the audience will make the effort to study both our chapter and Myers's own.

The last of the key empirical topics covered in *IM* is mystical experience, the treatment of which by modern Western science (and philosophy) has so far, in my opinion, been nothing short of scandalous - far worse even than its treatment of creativity. Unlike the mostly Eastern religious and philosophical traditions that have celebrated mystical experiences, viewing them as windows into deeper parts of reality, our

Western scientific response has consisted mainly of ignoring the subject altogether, and when not ignoring it, inappropriately demeaning and pathologizing it. In our chapter Michael Grosso and I review and rehabilitate the subject in some depth, beginning with its sympathetic treatment by William James in the *Varieties*. Along the way we dismantle the supposed evidence for close connections between mystical experiences and brain pathologies such as temporal lobe epilepsy (TLE). We also sharply critique the radical contextualism of Steven Katz and many other modern scholars of religion and provide qualified justification for the more universalist or common-core views of people such as Aldous Huxley and Walter Stace, along with William James himself. We end by appealing for intensified scientific study of mystical experiences, using psychedelics and meditation as vehicles for inducing them.

That should be enough to provide an overall sense of the main topics covered in detail in *IM*. I believe this first book of ours accomplished two key things: First, it went a long way toward demonstrating on *empirical* grounds that physicalism is just not up to the job of explaining important aspects of human mind and consciousness, in this respect complementing the more theoretical criticisms that have recently emerged among philosophers of mind.[5] Second, and even more significantly, I think it went a long way toward establishing, or helping to establish, Myers and James's radically different way of thinking about the mind-brain relationship. Let me expand a bit here on this latter claim.

I've already described the currently prevailing physicalist *production* model, according to which neurophysiological processes going on in our brains manufacture (in some unknown fashion) everything in mind and consciousness. On this view our everyday consciousness is all the consciousness there is, created and supported by unconscious physical processes in our brains. Myers and James, however - supported by philosophical colleagues such as Henri Bergson and F. C. S. Schiller -

[5] David Chalmers in particular is often credited with making more people recognize and take seriously "the hard problem" of consciousness - the explanatory gap between physical events in the brain and the "what it's like" to be in a particular conscious state - but that problem had already been clearly identified at least as far back as John Tyndall in the mid-19th century. I have the distinct impression that allegiance to physicalist accounts of consciousness is rapidly dropping among professional philosophers of mind, especially the younger ones.

were developing a very different and much richer picture of the human psyche, one that I and many others believe is much closer to the truth and deserves renewed attention today. James made the crucial logical point in his Ingersoll lecture at Harvard (James, 1900/1898): The correlation normally holding between mental events and brain events - which everybody accepts and which is conventionally interpreted as unambiguously supporting the production model - can in fact be interpreted at least equally well in terms of *transmission* or *permission* of mental content originating outside the brain. Although this picture initially seems purely metaphorical and difficult to understand in detail, it is in reality no more so than the production model, and it has the great advantage of potentially explaining a variety of things beyond the reach of the production model itself such as the phenomena then being uncovered by Myers and his colleagues in psychical research. The central thrust of Myers's great 1903 book *Human Personality* was to advance a theory of just this sort, in which everyday consciousness is *not* all the consciousness there is, but is itself embedded within a larger and more capacious consciousness endowed with "adits and operations" of its own that may account for things like psi phenomena and the subliminal uprushes of genius, and that can potentially survive bodily death.[6]

Irreducible Mind required plenty of hard work, but it was actually the easier part of our Esalen CTR project, consisting mainly of the clerical-type task of digging enormous amounts of relevant information out of the past century or so of refereed biomedical literature and assembling it all in one place in coherent form. Following publication of *IM* in 2007 we began work on the much more difficult theoretical part, which was to try to identify a possible successor to physicalism. If the world is not constituted in the manner described by physicalism, that is, how must it be constituted differently, in order that the rogue phenomena catalogued

[6] The best available short introduction to Myers and his theory is provided by Emily in Chapter 2 of *IM*. Note that although this Myers/James *permission* model circumvents the "hard problem" of consciousness and the biological objection to postmortem survival, it does not in the least diminish the value and importance of our steadily improving techniques for characterizing and monitoring the global neuroelectrical activity of the human brain. The only difference is that "neural correlates of consciousness" are to be understood as conditions in the brain that permit the fitful expression of capacities originating elsewhere, rather than as conditions permitting the brain itself to manufacture the forms of mentation under study.

in *IM* - along with everything else in nature - can occur? This is the main subject of our following two books and my own ongoing theoretical work today. I don't want to go into this part of the project in any depth, because that would take us too far afield from the main subject here, which is creativity, but I do want to indicate briefly what we've done and where we've come out (so far). The "we" here, parenthetically, consists of the 50 or so scholars from a diversity of academic disciplines who have contributed in one way or another to the evolution of this CTR project to date.

Our basic approach has been to examine a wide variety of world-historical conceptual frameworks or philosophical systems or worldviews that take our rogue phenomena seriously and attempt to account for them (or at least make room for them) in some way. These have included for example contemporary physics-based theories that draw directly upon quantum theory and/or relativity theory, mystically informed religious philosophies such as Neoplatonism and the Indian philosophical tradition, and the systems of Western metaphysical philosophers including Leibniz, Hegel, Peirce and Whitehead. What gradually became apparent is that theorizing which begins with an adequately comprehensive empirical foundation - i.e., one that takes into account phenomena systematically ignored by physicalism - leads almost inevitably to what amounts to its metaphysical opposite - a realist form of idealism. We have not yet converged upon a version that we can all agree upon, but this is the strong central tendency of our work to date. As described in detail in chapter 14 of *Beyond Physicalism*, my own trajectory has closely followed that of William James in his late work, building explicitly upon Myers's psychological theory and toward a form of evolutionary panentheism (see especially James, 1971/1909 and Hartshorne & Reese, 2000/1953), The core idea here is that our everyday experience of ourselves as separate individuals inhabiting a mostly shared world of objects arises somehow from an underlying greatest consciousness or Mind-at-Large. The central goal of our ongoing theoretical efforts is to explain as best we possibly can how that process might actually work, in a manner that incorporates or at least honors the major discoveries of modern physics.

The essential take-home point here is that physicalism can no longer pretend to be the only game in town, because philosophically and

scientifically respectable alternatives are already on offer, and more are in the works. Let me also just add that what I've been able to provide here concerning our three books is only a thumbnail sketch of what amounts to almost 2000 pages of evidence and argument. I certainly don't expect all of you to agree with everything I've said, but I do hope that many of you will have recognized that it merits serious consideration.

Now let's get back to creativity in the context of the expanded *psychological* picture that Myers and James were developing. As indicated above, they view the inspirations of genius, together with psi phenomena and mystical experiences, as emerging from the deeper conscious region of the psyche that Myers called the subliminal and Janes the B-region, or "The More".[7] What can presently be said in terms of empirical justification for this picture? Well, at the most basic level it certainly leads to an expectation that pairwise correlations will be found among these three large classes of phenomena, and these correlations appear definitely to exist. In regard to connections between creativity and psi, for example, you've already heard a good bit during this conference from Christine Simmonds-Moore and Marilyn Schlitz, both of whom pointed to substantial evidence of such connections in the existing literature of experimental parapsychology. There have also been many striking cases of spontaneous psi events occurring in the lives of creative writers, artists, and scientists, noteworthy collections being that of Prince (1928/1963) and Charles Tart's archive of spiritual and psi experiences reported by scientists (https://www.aapsglobal.com/taste). At a more fundamental level, the classic 4-stage model of the creative process has a close parallel in the recipe that Rhea White (1964) independently derived from a sample of exceptionally successful psi performers aiming for difficult free-response targets such as hidden drawings or objects (vs. forced-choice tasks using ESP cards and the like). Specifically, her recipe calls for an initial period of sensory isolation and relaxation followed by a demand for the needed information (preparation), followed by release of effort and a waiting period (incubation), eventuating in spontaneous

[7] Parenthetically, Myers and James do not naively portray this normally hidden region as containing only good stuff: Myers describes it explicitly as both a treasure house and a rubbish heap, and as James puts it, "seraph and snake abide there together".

emergence of information into consciousness, often in symbolic visual or auditory form (inspiration), followed by evaluation or elaboration of the information so received (verification). The predicted connection between creativity and psi, in short, seems definitely to exist.

What about connections between genius and mystical experience? Well, literary critic Harold Bloom compiled a list of what he viewed as the 100 greatest contributors to the Western canon, and his list overlaps substantially with one independently compiled by psychiatrist R. M. Bucke of persons who have experienced "cosmic consciousness" - the name Bucke gave to his own mystical experience as described by William James in the *Varieties*. This is not the result of a formal scientific study, of course, but it satisfies what statisticians jokingly refer to as the (non-parametric) "IOT" test - InterOcular Trauma; it socks you right between the eyes. So this predicted connection appears to hold as well.

Finally, what about the predicted connection between mystical experience and psi? Well, scholars of religion, like humanistic scholars in general, have too often been cowed by physicalist colleagues into ignoring or summarily dismissing reports of psi-type events, but it is already clear that many relevant events and cases can be found scattered about in the enormous worldwide literature on the subject of mysticism (see for example Eire, 2023; Marshall, 2011; Thurston, 1952). There is also a great deal of anecdotal lore, and a modest amount of preliminary experimental work, indicating that psi-type events commonly occur in conjunction with mystical experiences induced by major psychedelics such as psilocybin and LSD. So this connection too appears to hold, although much more work is obviously needed.

In sum, genius, mystical experience and psi do appear to display the expected pairwise correlations, empirically, and in fact all three are sometimes conspicuously present in the same persons. Indeed, one such person, the Alexandrian mystical philosopher Plotinus - "the eagle soaring above the tomb of Plato" - was for Myers himself the very paragon of creative genius.

Much additional work could usefully be carried out along lines already described, but clearly the central scientific task for future research is to identify physiological conditions in the brain that permit influx from the normally hidden Myers/James subliminal region of the psyche. Berkeley

neurobiologist David Presti and I took a first stab at that in Chapter 4 of *Beyond Physicalism* (the second CTR volume), reviewing what little is currently known about creativity, psi, and mystical experience in terms of their accompanying physiological conditions, and we ended up by tentatively identifying what appears to be a plausible neurobiological counterpart to Myers's central *psychological* principle - namely, that the subliminal is enabled to express itself in proportion to the abeyance of the supraliminal or everyday consciousness. Specifically, we suggested that the recently discovered Default Mode Network (DMN) may be an important player in all these phenomena. The DMN, you see - consisting mainly of midline structures such as medial prefrontal cortex, anterior and posterior cingulate cortex, and some temporal and limbic regions with which they are strongly coupled anatomically and functionally - can be thought of at least roughly as the neural embodiment of the everyday self or ego. One of the most interesting results from the initial functional neuroimaging studies of mystical-type states induced by psychedelics has involved the role of the DMN. In the initial fMRI studies by Carhart-Harris et al. (2012) of responses to injected psilocybin, for example, and contrary to widespread expectation, no *increases* of activation occurred anywhere in the brain. Instead, the self-reported intensity of psychedelic experiences correlated most specifically with the degree to which major nodes of the DMN were *deactivated* and *decoupled*. Similar effects have been reported in relation to phenomena such as deep meditation, mediumistic and hypnotic "trance", and automatic writing, and one wonders whether these can all be understood as movements in the direction of NDEs occurring in conjunction with deep general anesthesia and/or cardiac arrest, as described previously. Perhaps most significant for present purposes, Carhart-Harris & Friston (2010) have explicitly made a direct connection between these psilocybin findings and creativity, arguing that they open a path to interpretation of the old psychoanalytic conception of primary and secondary process in contemporary neurobiological terms. Indeed, they congratulate themselves for rehabilitating this theoretically useful but long-neglected concept.[8]

[8] On their own physicalist understanding, of course, whatever novelties enter into creative activity by way of primary process can only come from somewhere else in the brain; but please note right away that this presumption is belied by the reality of psi.

Getting the everyday self or ego out of the way seems likely to be part of what needs to happen, and note that the DMN story overlaps substantially with the "transient hypofrontality" hypothesis of Dietrich (2003). The full picture is undoubtedly much more complicated, however (and see Abraham, 2024, Chapter 7 for related cautions). Such complexity was clearly anticipated by Myers himself, who speaks of the subliminal consciousness as expressing itself fitfully, and only partially, "through an organism not so framed as to afford it full manifestation" (Myers, 1903, vol. 1, p. 15). What emerges, that is, under conditions that permit some degree of subliminal uprush, is likely to depend in detail on the totality of conditions present in the brain in the particular circumstances at hand, rather than on some single more global parameter. This is consistent with Myers's own picture of creative inspiration as an intensified form of the normal cooperation of supraliminal and subliminal processes.[9]

I believe that future research on both creativity and psi will profit from intensified study of mystical experience - the importance and centrality of which is for me a key deliverance of our CTR project - and the prospects for such research are now greatly improved. Most previous work on the subject has been carried out by scholars of religion working with mystical texts of one sort or another, and these studies have been chronically plagued with methodological difficulties such as the possible corruption of first-person reports through enforcement of doctrinal compliance by local authorities, quality of the available translations, and problems inherent in the attempt to interpret obscure texts of dubious authenticity. But we now know that spontaneous mystical experiences are continuing to happen worldwide, and are probably not all that uncommon, so that experiencers could in principle be identified and studied in the manner of the IPAR studies of creative individuals.[10] More importantly, it is becoming increasingly possible to study mystical

[9] Some of the metaphors currently in circulation are certainly too simplistic. Aldous Huxley and others, for example, have suggested that the brain be thought of simply as a sort of *valve* that reduces Mind-at-Large to the measly trickle of everyday consciousness, but this implies that the two sides differ only in volume, and not in kind. The more common *filter* metaphor similarly implies that the state of the brain simply selects some portion of what already exists fully developed in a deeper region of the psyche. *Permission* seems closer to the mark, though itself hardly ideal.

[10] Work in this direction is cited by Paul Marshall (2005) in his excellent survey and discussion of mystical experiences worldwide.

experience *experimentally*, using modern functional neuroimaging and neurophenomenological techniques, thanks in particular to the ongoing psychedelic renaissance and the burgeoning interest of federal funding agencies in meditation, with its implications for public health.

To the extent we succeed in identifying physiological conditions associated with improved access to The More, we could then also get serious about developing improved technological means for inducing or stabilizing them - for example using as-yet-undiscovered forms of biofeedback, or perhaps transcranial stimulation using focused ultrasound or electromagnetic fields - with the expectation that improved access to associated phenomena such as creative inspiration and psi would come along for the ride. Such possibilities are probably still a long way off, but they clearly have potentially enormous implications not only for future research on creativity and psi but for individual and collective human good as well. If I were a young person just getting started on my research career I would definitely be heading in that direction.

Meanwhile, I want to conclude this talk with some more tentative remarks on a subject that occupies the growing edge of my own thinking about creativity. Many of you will have noted, I'm sure, that much of what I've proposed here in terms of future creativity research could be (and probably will be) pursued from the standpoint of the prevailing physicalism, without commitment to the expanded science-based worldview my CTR colleagues and I have been struggling to develop. There is one particular point, however, at which I think deeper understanding of genius will ultimately require such a commitment. Let me elaborate here on what I have in mind.

Throughout its history, scientific psychology has been stuck in a sort of no-man's land between the hard sciences and the humanities, and we're still struggling to find our own proper foundations. One symptom of this state of affairs is our continuing inability to deal with the conscious grasping and use of *meanings*, as described above, which for me represents a still mostly unrecognized "gorilla in the midst" of cognitive science. I further suspect that in the unusual forms of meaning accessible through higher states of consciousness lie the deepest secrets of creativity itself. What I'm alluding to here is closely tied to what physicist Eugene Wagner famously called "the unreasonable effectiveness of mathematics"

in revealing and characterizing properties of the world in which we find ourselves, but the underlying issue is really more general even than that. In brief, there seems to be some sort of hidden concordance between the structure and operations of our individual minds and the structure and operations of the natural world itself. Pure mathematicians in particular have always tended strongly to be Platonists - insisting that mathematical truths are found, not made - and some, such as Roger Penrose and Fields medalist Alain Connes, still vocally are (see Atmanspacher & Rickles, 2022, section 7.1). Ramanujan (the apotheosis of intuition) and his discoverer Hardy (the master of proof) were modern Platonists as well. Myers in his chapter on genius expresses definite leanings in this direction, in his case grounded mainly in deep knowledge of poetry and literature, and he also speaks of music in particular as "like something discovered, not like something manufactured; - like wine found in a walled-up cellar rather than like furniture made in the workshop above". Myers recognized that mathematics could be an especially critical arena in which to approach this topic, but he had not been able to find much information about creative activity in great mathematicians, and he specifically acknowledged and lamented that defect in his presentation. And yet he was stunningly prescient, in my opinion, in identifying a related phenomenon of profound and still mostly unrecognized theoretical importance - the "calculating boy" - who for him exemplified in simplified fashion the "uprush" - through some sort of vent-hole in the organism - of information deriving from a region beyond normal ken. The genius chapter in *IM* provides much additional information both about mathematicians including Ramanujan and about "savant syndrome", the modern term embracing calculating prodigies and related skills, but it's the latter I want to emphasize here for expository convenience.

Consider for example "the twins" as described by Sacks (1987). These severely autistic individuals were unable to add and subtract single-digit numbers with any degree of consistency, and yet they proved able to play a game in which they playfully and quickly exchanged successively larger and ultimately huge *prime* numbers. Sacks was able to verify the primacy from published tables, but only up to a length of 10 digits, while the twins themselves went out as far as 20. Computers are normally required to identify and test such large numbers, and that process takes time: How

could the twins possibly have done it?

Myers himself was a keen student and admirer of Plotinus, whose philosophical system is a member of the idealist family of conceptual frameworks that our Esalen CTR project has converged toward as harboring the most promising candidates to replace physicalism. His system, described by Gerson (2013) as the culmination of the entire Platonic tradition, portrays our experienced world as emerging in (metaphysical) stages from an underlying universal consciousness (The One), and the first of those stages consists of an "intelligible world" (Nous) containing things such things as mathematical truths and the Platonic forms of beauty and goodness. Long-discarded ideas of this sort are currently undergoing a considerable revival in philosophical circles, and like Myers and the mathematicians I suspect they are more or less literally correct. Full scientific understanding of creativity, I suggest, will ultimately require something of just this sort.

There we must leave it, at least for now. Thank you for your attention!

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POSTER APRESENTADO PELA
FUNDAÇÃO BIAL
POSTER PRESENTED BY
THE BIAL FOUNDATION

Resumo do poster apresentado pela Fundação BIAL
Abstract of the poster presented by the BIAL Foundation

EVALUATION OF THE PERFORMANCE OF THE BIAL FOUNDATION'S GRANTS

***Marinho S.*[*], *Guedes, P.*[*] *& Sousa, N.*[*]**

Background

Bibliometric indicators have been considered reliable and informative tools to assess scientific research performance and impact, as long as their limitations are acknowledged. With the creation of an online database in 2014, the BIAL Foundation started performing bibliometric analysis for a more systematic and quantitative assessment of projects' productivity over the years, complementing the qualitative analysis of the scientific reports.

Aims

To monitor and analyse the scientific performance and impact of projects supported by the BIAL Foundation by using bibliometric indicators.

Method

The research projects' productivity was assessed through the number of publications indexed in Scopus or Web of Science (WoS) databases, excluding abstracts. The publications' impact was assessed by "times cited" retrieved from WoS Core Collection in February 2024, considering the total number of citations and the citations per paper (quotient obtained by dividing number of citations by number of papers). The BIAL Foundation *h*-index was calculated by combining the number of indexed papers (i.e., productivity) with the number of times they have been cited (i.e., impact). Moreover, for papers published between 2013 and 2023, the number of citations was compared with the expected number of

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citations for papers in the same research field and publication year, based on field baselines percentiles dataset of Essential Science Indicators (ESI) and ESI journal list, updated on January 11th, 2024. The *Highly Cited Papers*, featuring those that rank in the top 1% by citations for field and publication year in WoS, were also retrieved. The journals' performance was assessed by their impact factor and mainly by their quartile score (provided by Journal Citation Reports) in order to mitigate differences between research fields. When a journal was assigned to different quartiles (i.e., Q1, Q2, Q3 or Q4) depending on the subject category, the highest quartile was chosen. Globally, the results were compared with the previous assessment made in March 2022, following the same criteria, to determine the development trend.

Results

Since 1994, the BIAL Foundation has approved for funding 865 projects and supported 847 projects, in the areas of Psychophysiology (430 grants, 51%), Parapsychology (253 grants, 30%) and Interdisciplinary - a combination of Psychophysiology and Parapsychology (164 grants, 19%).

The 847 projects have produced 2457 papers from 1995 to March 2024, out of which 1957 were indexed in Scopus or WoS. In comparison with the previous analysis made in 2022, additional 351 indexed papers were published, which represents an increase of 22%.

Excluding the last 2 grant editions (2020/21 and 2022/23), in which most projects are still ongoing or starting, it was obtained a ratio of 2.63 indexed papers per project (1815 papers from 690 projects). This represents an improvement given that in previous analysis the ratio was 2.43.

Overall, a total of 45.764 citations were counted, with 1770 papers being cited on average 26 times (M = 25.86), ranging from 0 to 652 citations. Comparing to 2022 this constitutes an increase of 30% in terms of number of citations. The BIAL Foundation h-index went from 80 in 2022 to 97 in 2024, that is, 97 papers were cited 97 times or more. Between 2013 and 2023, 10% of the papers (n = 236) ranked in the top 10% by citations for field and publication year and 18 were *Highly Cited Papers*.

Of the indexed papers, 1718 were published in journals with an

average impact factor of 4.2, representing an increase of 26%, since the previous assessment.

The majority of papers were published in journals of quartile 1 (n = 808; 47%) and quartile 2 (n = 510; 30%).

Conclusions

Bibliometric indicators provide a basis for ongoing analysis of the performance of supported projects, and may support decision-making during grant lifecycle, from pre- to post-award. When comparing the present results with the previous assessment conducted in 2022, the increase of indexed publications per project and the total number of citations is noteworthy.

Keywords

BIAL Foundation grants, Indexed publications, Citations, Field baselines, Impact factor, Quartiles.

LISTA DE POSTERS
POSTERS

Posters com resultados finais apresentados pelos investigadores apoiados pela Fundação BIAL e/ou disponíveis em www.bialfoundation.com

Posters with final results presented by the BIAL Foundation grant holders and/or available at www.bialfoundation.com

Resumos dos posters disponíveis em / *Posters' abstracts available at* www.bialfoundation.com

2016

76/16 – "Unleashing the hidden powers of the mind through manipulating belief in cognitive enhancement devices" – only abstract available
Researchers: Michiel van Elk, Uffe Schjoedt, Marcel Brass
Institutions: Department of Psychology, University of Amsterdam (The Netherlands); School of Culture and Society - Department of the Study of Religion, University of Arhus (Denmark)
Duration: 2017/03 – 2022/10

206/16 – "Developing a neurofunctional intervention for emotion regulation under stress"
Researchers: Pedro Morgado, Carles Soriano Mas, Paulo Marques, Pedro Moreira, Ricardo Magalhães
Institutions: Life and Health Sciences Research Institute - ICVS, School of Health Sciences, University of Minho, Braga (Portugal); Department of Psychiatry, Bellvitge Biomedical Research Institute - IDIBELL, Barcelona (Spain)
Duration: 2017/01 – 2023/01

249/16 – "Healthy aging and economic decision-making: Neuropsychophysiological examination of the affect-integration-motivation framework of decision-making in aging brain"
Researchers: João Marques-Teixeira, Rui Mata, Isabel Martins, Giuseppe Danese, Ana Gonçalves, Carina Fernandes, Rita Pasion
Institution: Laboratory of Neuropsychophysiology, Faculty of Psychology and Education Sciences of the University of Porto (Portugal)
Duration: 2018/02 – 2023/04

280/16 – "Probing the unconscious mind with instrumental hypnosis"
Researchers: Mathieu Landry, Jérôme Sackur, Amir Raz
Institutions: Laboratoire de Sciences Cognitives et Psycholinguistique, École Normale Supérieure, Paris (France); Raz Cognitive Neuroscience Lab, McGill University, Montreal (Canada)
Duration: 2018/06 – 2023/11

292/16 – "Oxytocin: On the psychophysiology of trust and cooperation"
Researchers: Diana Prata, James Rilling, Manuel Lopes, Duarte Ferreira, Daniel Martins, Pedro Levy
Institutions: FCiências.ID – Associação para a Investigação e Desenvolvimento de Ciências (Portugal); Emory University, Atlanta (USA)
Duration: 2017/10 – 2023/11

2018

37/18 – "Decoding the neuron-astrocyte dialogue that supports cognitive processing"
Researchers: João Filipe Oliveira, Luísa Pinto, Diana Nascimento, Sónia Gomes, Inês Caetano, João Viana, João Luís Machado, Daniela Sofia Abreu, Sara Barsanti
Institution: Life and Health Sciences Research Institute - ICVS, Universidade do Minho, Braga (Portugal)
Estimated duration: 2019/03 – 2024/04

67/18 – "Electrophysiological correlates of size-distance integration"
Researchers: Irene Sperandio, Louis Renoult
Institution: Department of Psychology and Cognitive Science, University of Trento, Rovereto (Italy)
Estimated duration: 2020/11 – 2024/04

68/18 – "Investigating biochemical mechanisms underlying mind-matter interactions: Effect of intention on human stem cell properties via cryptochrome"
Researchers: Yung-Jong Shiah, George T.-J. Huang
Institutions: Graduate Institute of Counseling Psychology and Rehabilitation Counseling, National Kaohsiung Normal University, Kaohsiung, Taiwan (China); University of Tennessee Health Science Center, Memphis (USA)
Duration: 2019/03 – 2023/03

81/18 – "Meditation as a first-person method in the neuroscience of consciousness: A comparison of the informativeness and reliability of first person data collected from meditators and non-meditators in a novel Libet paradigm"
Researchers: Stefan Schmidt, Sebastian Kübel, Marc Wittmann, Han-Gue Jo
Institution: Department of Psychosomatic Medicine and Psychotherapy, University Medical Center Freiburg (Germany)
Estimated duration: 2020/11 – 2024/04

85/18 – "Role of NT3/TrkC in the regulation of fear"
Researchers: Mónica Santos
Institution: Center for Neuroscience and Cell Biology, University of Coimbra (Portugal)
Duration: 2019/03 – 2023/07

89/18 – "National survey of "Cases of Reincarnation Type" in Brazil"
Researchers: Alexander Moreira-Almeida, Jim Tucker, Lucam Moraes, Sandra Carvalho
Institutions: Research Center in Spirituality and Health - NUPES, School of Medicine, Federal University of Juiz de Fora – UFJF (Brazil); Division of Perceptual Studies - DOPS, School of Medicine, University of Virginia, Charlottesville (USA)
Estimated duration: 2019/04 – 2024/04

110/18 – "A randomized trial: Extraordinary experiences and performance on psi tasks related to meditation"
Researchers: Jennifer Kim Penberthy, Marieta Pehlivanova, Elizabeth Hanchak, Leslie Hubbard
Institution: Division of Perceptual Studies - DOPS, School of Medicine, University of Virginia, Charlottesville (USA)
Duration: 2020/05 – 2024/01

135/18 – "The physiological role of circadian rhythms in memory"
Researchers: Luísa Lopes, Miguel Remondes, Ana Morgado, Joana Coelho
Institution: Instituto de Medicina Molecular - João Lobo Antunes, Lisboa (Portugal)
Duration: 2019/01 – 2023/01

148/18 – "Voice perception in the visually deprived brain: Behavioral and electrophysiological insights"
Researchers: Tatiana Conde e Magro, Ana Pinheiro, César Lima, João Sarzedas
Institutions: Centro de Investigação em Ciência Psicológica - CICPSI, Faculdade de Psicologia da Universidade de Lisboa (Portugal); Centro de Investigação e de Intervenção Social, ISCTE - Instituto Universitário de Lisboa (Portugal)
Duration: 2020/02 – 2023/09

156/18 – "Examining observer effects on random processes: A correlation matrix" – only abstract available
Researchers: Ana Flores
Institution: Life and Health Sciences Research Institute - ICVS, School of Health Sciences, University of Minho, Braga (Portugal)
Duration: 2019/07 – 2024/02

169/18 – "Temporal decoding of selective recollection with psychophysiology"
Researchers: Alexa Morcom, Arjen Alink
Institution: School of Psychology, University of Sussex (UK)
Duration: 2019/06 – 2022/05

188/18 – "COping with PAin through Hypnosis, mindfulness and Spirituality (COPAHS)"
Researchers: Maria Alexandra Ferreira Valente, José Luís Pais Ribeiro, Mark Philip Jensen, Ana Filipa Pimenta, Rui Miguel Costa, Melissa Day
Institutions: William James Center for Research, ISPA – Instituto Universitário, Lisboa (Portugal); Department of Rehabilitation Medicine, University of Washington, Seattle (USA)
Duration: 2019/10 – 2023/01

198/18 – "Sense of agency in the Ouija board experience" – only abstract available
Researchers: Gethin Hughes, Peter Gooding
Institution: Department of Psychology, University of Essex (UK)
Estimated duration: 2019/04 – 2024/04

204/18 – "Boosting WM capacity by strengthening the oscillatory functional fronto-parietal pathway"
Researchers: Vincenzo Romei
Institution: Centre for studies and research in Cognitive Neuroscience - CsrNC, Department of Psychology, University of Bologna (Italy)
Duration: 2019/03 – 2023/04

210/18 – "Mind-matter interactions and the frontal lobes of the brain"
Researchers: Morris Freedman, Robert Chen, Malcolm Binns
Institutions: Division of Neurology, Baycrest Health Sciences, Toronto (Canada); Division of Neurology, University Health Network - UHN, Toronto (Canada)
Duration: 2019/07 – 2023/11

220/18 – "Mind-shaped body: A new conceptual framework beyond the placebo effect connecting expectations to disease outcome"
Researchers: Francesco Pagnini, Paolo Banfi, Cesare Cavalera, Eleonora Volpato
Institutions: Department of Psychology, Università Cattolica del Sacro Cuore, Milan (Italy); Respiratory Rehabilitation Unit, Fondazione Don Carlo Gnocchi, Milan (Italy)
Duration: 2019/02 – 2022/03

252/18 – "Spiritual states induced by ayahuasca, and the involvement of the reward system"
Researchers: Miguel Castelo-Branco, Gisela Lima, Miguel Raimundo, Pedro Fonseca, Carla Cavaleiro, Lorena Petrella, Célia Cabral, Antero Abrunhosa
Institution: Institute for Nuclear Sciences Applied to Health - ICNAS, University of Coimbra (Portugal)
Duration: 2019/10 – 2022/09

287/18 – "More thankful, less stressed? Gratitude and physiological reactions to stress"
Researchers: Brenda O'Connell, Stephen Gallagher, Brian Leavy
Institutions: Centre for Mental Health & Community Research, Department of Psychology, Maynooth University (Ireland); Study of Stress, Anxiety and Health Laboratory, Department of Psychology, University of Limerick (Ireland)
Duration: 2019/09 – 2023/10

296/18 – "The power of mind: Altering cutaneous sensations by autosuggestion"
Researchers: Elena Azáñon, Esther Kuehn, Kasia Myga
Institution: Institute of Psychology, Faculty of Natural Sciences, Otto-von-Guericke University, Magdeburg (Germany)
Duration: 2019/11 – 2023/11

306/18 – "The neural circuitry underlying error monitoring during social cognition"
Researchers: Teresa Sousa, Miguel Castelo-Branco, João Castelhano, Verónica Figueiredo, Andreia Pereira
Institution: Institute for Nuclear Sciences Applied to Health - ICNAS, University of Coimbra (Portugal)
Duration: 2019/10 – 2022/09

320/18 – "The role of interneurons in spatial memory"
Researchers: Tiago Gil Oliveira, Patrícia Monteiro, Vítor Pinto, André Miranda, Ricardo Silvestre, Luísa Marinha, Rafaela Morais-Ribeiro
Institution: Life and Health Sciences Research Institute - ICVS, University of Minho, Braga (Portugal)
Estimated duration: 2019/10 – 2024/04

331/18 – "Frontostriatal neurophysiological underpins of decision-making"
Researchers: Hugo Leite-Almeida, Madalena Esteves, Marco Rafael Guimarães, Ana Margarida Cunha, Joana Mendes, Armando Almeida
Institution: Life and Health Sciences Research Institute - ICVS, University of Minho, Braga (Portugal)
Estimated duration: 2020/02 – 2024/04

336/18 – "Research-inspired cognitive empowerment: Modulating Episodic Memory through Egocentric Navigational Training (MEMENT)" – only abstract available
Researchers: Giorgia Committeri, Carlo Sestieri, Matteo Frisoni, Agustina Fragueiro, Annalisa Tosoni
Institution: Department of Neuroscience, Imaging and Clinical sciences, Institute for Advanced Biomedical Technologies, University G. d' Annunzio of Chieti-Pescara (Italy)
Duration: 2021/09 – 2023/04

347/18 – "Driving synaptic plasticity in motor-to-visual neural pathways to enhance action prediction"
Researchers: Alessio Avenanti, Marco Zanon
Institution: Department of Psychology, Alma Mater Studiorum - Università di Bologna (Italy)
Duration: 2019/10 – 2023/06

355/18 – "The implicit cognition of interpersonal attraction"
Researchers: Joana Arantes, John Wearden, Mavilde Arantes, Emanuel Albuquerque
Institution: Psychology Research Center - CIPsi, School of Psychology, University of Minho, Braga (Portugal)
Duration: 2019/05 – 2024/02

359/18 – "A Comparison of NN-DMT, Changa & 5-MeO-DMT and the Near-death Experience: Qualitative analyses and reviews of the neuroscience"
Researchers: Pascal Michael, David Luke
Institutions: Department of Psychology, Social Work and Counselling, Greenwich University, London (UK); Psychedelic Research Group, Imperial College London (UK)
Estimated duration: 2020/01 – 2024/04

366/18 – "Transpersonal imagery and bereavement: The psychomanteum and virtual reality"
Researchers: Marilyn Schlitz, Dorote Lucci, Donna Dulo, Kelly Yi, Lincoln Nguyen
Institutions: Institute of Transpersonal Psychology Foundation, Palo Alto, California (USA); Sofia University, Palo Alto, California (USA)
Estimated duration: 2021/05 – 2024/04

2020

24/20 – "World-relative object motion: How the brain detects object motion while we are moving" – only abstract available
Researchers: Valentina Sulpizio
Institution: IRCCS Fondazione Santa Lucia, Rome (Italy)
Duration: 2021/10 – 2024/01

26/20 – "Anticipation and experience of stressful situations and their psychobiological impact on providing pre-hospital emergency medicine care"
Researchers: Mark Wetherell, Jeff Doran
Institutions: Department of Psychology, Northumbria University Newcastle (UK); Great North Air Ambulance Service (UK)
Estimated duration: 2021/09 – 2024/04

73/20 – "Cerebrovascular hypothesis of stress-induced behavioral alterations"
Researchers: Ana Paula Silva, Filipa Baptista, Ana Rita Gaspar, Ricardo Leitão, Catarina Gomes
Institution: Centre for Innovative Biomedicine and Biotechnology - CIBB, Faculty of Medicine, University of Coimbra (Portugal)
Estimated duration: 2021/09 – 2024/09

79/20 – "Redefining the boundaries between cognition and action through the psychophysiological investigation of binary decisions"
Researchers: Michele Scaltritti, Simone Sulpizio
Institutions: Department of Psychology and Cognitive Science, University of Trento, Rovereto (Italy); Università degli Studi di Milano-Bicocca (Italy)
Duration: 2021/02 – 2023/09

86/20 – "Age-related changes in motor-cognitive dual-tasking: An electrophysiological investigation of interference at the level of sub-task elements"
Researchers: Subhobrata Mitra, Christina Howard
Institution: Psychology Department, Nottingham Trent University (UK)
Estimated duration: 2021/10 – 2024/04

107/20 – "Attitudes and beliefs as predictors of psi effects in a pseudo-gambling task" – only abstract available
Researchers: Lance Storm
Institution: School of Psychology, University of Adelaide (Australia)
Duration: 2022/01 – 2023/11

108/20 – "A telephone telepathy study: Does genetic relatedness influence psychic abilities?"
Researchers: Helané Wahbeh
Institution: Institute of Noetic Sciences, Novato (USA)
Duration: 2021/03 – 2023/09

123/20 – "A latent profile analysis and structural equation modelling of paranormal belief, psychopathological symptoms, and well-being"
Researchers: Neil Dagnall, Andrew Denovan
Institution: Health, Psychology and Communities, Manchester Metropolitan University (UK)
Duration: 2021/02 – 2023/06

129/20 – "Investigating the role of expertise in the predictive coding framework combining time resolved neural and behavioural evidence"
Researchers: Marie Smith, Inês Mares, Louise Ewing, Fraser Smith
Institution: Department of Psychological Sciences, Birkbeck, University of London (UK)
Estimated duration: 2021/08 – 2024/02

131/20 – "From inner to dyadic connection: The effect of mindfulness intervention on mother-infant bio-behavioural synchrony"
Researchers: Maria Spinelli, Chiara Suttora, Filippo Zappasodi
Institutions: Department of Neurosciences, Imaging and Clinical Sciences, Università degli Studi "G. d'Annunzio" Chieti - Pescara (Italy); Alma Mater Studiorum, Università di Bologna (Italy)
Estimated duration: 2021/09 – 2024/04

169/20 – "Investigation of the phenomenology and impact of spontaneous and direct After-Death Communications (ADCs)"
Researchers: Callum Cooper, Evelyn Elsaesser
Institution: Research Centre for Psychology & Social Sciences, University of Northampton (UK)
Estimated duration: 2021/02 – 2024/04

174/20 – "In your skin: The psychophysiology of touch observation" – only abstract available
Researchers: Bettina Forster
Institution: Department of Psychology, School of Arts and Social Sciences, City, University of London (UK)
Estimated duration: 2021/09 – 2024/03

191/20 – "Understanding the brain mechanisms of death-denial for fostering mindfulness-based existential resilience" – only abstract available
Researchers: Aviva Berkovich-Ohana, Yair Dor-Ziderman
Institutions: The Edmond J. Safra Brain Research Center, University of Haifa (Israel); Gonda Multidisciplinary Brain Research Center, Bar-Ilan University (Israel)
Duration: 2022/01 – 2024/01

203/20 – "Dynamic eye-movement encoding in human cortex using ultra-high field fMRI (7Tesla)" – only abstract available
Researchers: Alessio Fracasso
Institution: Institute of Neuroscience and Psychology, University of Glasgow, Scotland (UK)
Duration: 2021/10 – 2023/09

212/20 – "Comparing cognitive styles among parapsychology researchers, psi-believers, and skeptics"
Researchers: Marieta Pehlivanova, Bruce Greyson
Institution: Division of Perceptual Studies - DOPS, School of Medicine, University of Virginia, Charlottesville (USA)
Estimated duration: 2021/03 – 2024/04

216/20 – "Analysis of an entropic anomaly in 23 years of truly random data" – only abstract available
Researchers: Dean Radin
Institution: Institute of Noetic Sciences, Novato (USA)
Duration: 2022/01 – 2023/02

249/20 – "Physiological correlates to variations in ultra-weak photon emissions during periods of focused intent"
Researchers: John Kruth
Institution: Rhine Research Center, Durham (USA)
Estimated duration: 2021/05 – 2024/04

258/20 – "In God's shoes: Embodying the avatar of the supreme moral authority modulates psychophysiological indices of one's own morality"
Researchers: Salvatore Maria Aglioti, Michael Schepisi, Althea Frisanco, Gaetano Tieri
Institution: Department of Psychology, "Sapienza" University of Rome (Italy)
Duration: 2021/06 – 2023/09

276/20 – "Beyond your own body: Extending the bodily self to the neuroaesthetics of interactions"
Researchers: Andrea Orlandi, Matteo Candidi, Martina Fanghella, Quentin Moreau, Ugo Giulio Pesci
Institution: Department of Psychology, "Sapienza" University of Rome (Italy)
Estimated duration: 2021/02 – 2024/04

287/20 – "Title: Emotional distraction: Contextual modulation of attentional capture" – only abstract available
Researchers: Maurizio Codispoti, Cristina Filannino
Institution: Department of Psychology, University of Bologna (Italy)
Duration: 2021/04 – 2023/02

309/20 – "Assessing static and dynamic effects of mindfulness meditation on peripersonal space"
Researchers: Luca Simione, Salvatore Chiarella
Institution: Institute of Cognitive Sciences and Technologies, Italian National Research Council – CNR, Rome (Italy)
Estimated duration: 2021/11 – 2024/04

311/20 – "How body ownership shapes tactile awareness: Inducing phantom sensations and measuring their electrophysiological correlates in immersive virtual reality"
Researchers: Carlotta Fossataro, Valentina Bruno, Alice Rossi Sebastiano, Francesca Garbarini
Institution: Department of Psychology, University of Turin (Italy)
Duration: 2021/04 – 2024/01

344/20 – "Title: Evaluation of psychological traits, pain perception and muscular strength in trance experts"
Researchers: Olivia Gosseries, Paul Hollanders, Yannick Lafon, Aminata Bicego
Institution: GIGA Research Center, GIGA-Consciousness, University of Liège (Belgium)
Estimated duration: 2022/01 – 2024/04

347/20 – "Open-label choice blindness: Exploring the mechanism underlying auto-suggestion"
Researchers: Jeremy Olson, Despina Artenie, Ellen Langer, Jian Kong
Institutions: Department of Psychiatry, Massachusets General Hospital, Harvard Medical School, Boston (USA); Department of Psychology, Harvard University, Cambridge (USA)
duration: 2022/05 – 2023/09

360/20 – "Large scale online testing of psi abilities to identify and test talented individuals"
Researchers: Arnaud Delorme
Institution: Institute of Noetic Sciences, Novato (USA)
Estimated duration: 2021/04 – 2024/04

369/20 – "A trait-and-state analysis of precognitive remote viewing focusing on gender, emotions, and pregnancy status" – only abstract available
Researchers: Julia Mossbridge, Mark Boccuzzi, Kirsten Cameron
Institutions: The Institute for Love and Time - TILT, Sebastopol (USA); Windbridge Institute, LLC, Tucson (USA)
Duration: 2021/01 – 2022/09

384/20 – "Schema-based temporal memory in parietal cortex (SCHETEMP)"
Researchers: Matteo Frisoni, Paolo Capotosto
Institution: Department of Neurosciences, Imaging and Clinical Sciences, Università degli Studi G. d'Annunzio Chieti – Pescara (Italy)
Duration: 2021/10 – 2023/11

PALESTRANTES E MODERADORES
SPEAKERS AND MODERATORS

ANNA ABRAHAM Psychologist and neuroscientist, E. Paul Torrance Professor in the Mary Frances College of Education, University of Georgia, USA. Director of the Torrance Center for Creativity and Talent Development. Author of "The Neuroscience of Creativity" and Editor of "The Cambridge Handbook of the Imagination". Scientific interests: interdisciplinary examination of fundamentally human capacities such as creative thinking and other core aspects of the imagination including the reality-fiction distinction, self and social cognition, mental time travel, mental state reasoning, and aesthetic experience.

PEDRO ABRUNHOSA At the age of 16 he studied Analysis, Composition and History of Music at Porto School of Music, and, later, at the Conservatory, Porto, Portugal. He got into music through the erudite path; from the most complex to the simplest, towards the purification of language. When he got to jazz, he was a jazz scholar and founded the Porto Jazz School. When he arrived at rock music, he had a backpack full of history and rigor. In 1994 he released his first album "Viagens" and he is now finishing his ninth. In his multi-platinum albums, he reveals his powerful writing, leaving songs that join so many other hymns, legends, adages. With thousands of concerts and sold-out venues, he combines the stage with lectures and discussions in the business and academic world.

MARK BALDWIN Multi-award-winning choreographer, artistic director and visual artist. Academic Visitor, Department of Psychology, University of Cambridge, UK, where he works with Nicola Clayton. Scientific and artistic interests: thinking with and without words; choreography inspired by his background as a performer both as a dancer/choreographer and as Artistic Director of Britain's National Dance Company Rambert 2002-18. Made an Officer of the British Empire in 2015 for his services to dance.

FREDERICK BARRETT Associate Professor of Psychiatry and Behavioral Sciences, Johns Hopkins University School of Medicine; Faculty of Neuroscience, and Psychological and Brian Sciences, Johns Hopkins University; Director of the Johns Hopkins Center for Psychedelic and Consciousness Research, USA. Scientific interests: the neural basis of cognition and affect; the cognitive neuroscience of music, and the mechanisms underlying acute and enduring effects of psychedelic drugs.

ETZEL CARDEŃA Thorsen Professor of Psychology and Director of the Center for Research on Consciousness and Anomalous Psychology (CERCAP), Department of Psychology, Lund University, Sweden. Scientific interests: the psychology of anomalous experiences/non-ordinary mental expressions, including parapsychological phenomena; neurophenomenology of hypnosis, meditation and dissociation; stream of consciousness.

MIGUEL CASTELO-BRANCO Full Professor, University of Coimbra, Portugal.

Affiliate Professor, University of Maastricht, The Netherlands, where he has held a Professorship in Psychology in 2000. Before, Postdoctoral fellow, Max-Planck-Institute for Brain Research. Director of IBILI and Scientific Coordinator of the National Functional Brain Imaging Network. Director of CIBIT and former Director of ICNAS, University of Coimbra. Scientific interests: sensory and perceptual neuroscience, and neurobiology of decision-making; social cognition and reward in health and disease, with a focus on autism research.

NICOLA CLAYTON Professor of Comparative Cognition, Department of Psychology, University of Cambridge, UK. Fellow of Clare College and Fellow of the Royal Society, Director of the Cambridge Centre for the Integration of Science, Technology and Culture. She has worked with Mark Baldwin for almost fifteen years. Scientific and artistic interests: thinking with and without words; choreography inspired by comparative cognition.

AXEL CLEEREMANS Research Director with the F.R.S-FNRS (Belgium); Director of the Center for Research in Cognition & Neurosciences, Université Libre de Bruxelles; Member of the Royal Academy of Belgium. Scientific Interests: Consciousness; unconscious cognition; computational modelling of cognitive processes; agency; affective neuroscience.

RUI COSTA President and CEO, Allen Institute, Washington, and Professor of Neuroscience and Neurology, Columbia University, New York, USA. Scientific interests: molecular, cellular and systems mechanisms of action generation, sequence and skill learning, goal-directed actions versus habits, across-level approach to study cognitive and sensorimotor disorders (PD, OCD, and autism).

AMORY DANEK Postdoctoral Researcher and Lecturer, Department of Psychology, Heidelberg University, Germany. Founder of Insight without Borders (discussion forum for insight researchers across the world). Scientific interests: human problem solving; creativity; meta-reasoning; false insights; memory and magic tricks.

RAINER GOEBEL Professor of Cognitive Neuroscience, Faculty of Psychology and Neuroscience, Maastricht University, The Netherlands. Founding director of the Maastricht Brain Imaging Centre (M-BIC). Scientific interests: neuronal representations in the brain and how they are processed to enable specific perceptual and cognitive functions; neural correlates of visual awareness; clinical applications in brain computer interfaces (BCIs) and neurofeedback studies.

MICHAEL HANCHETT HANSON Director, Masters Concentration in Creativity and Cognition, Teachers College, Columbia University, USA. Member of the Chair,

Homo Creativus, l'Université de Paris-Cité, France. Secretary, International Society for the Study of Creativity and Innovation (ISSCI); Editor, Creativity in Practice series, Routledge. Scientific interests: systems-based analyses of creative development across lifespan and creative development within educational contexts.

EDWARD KELLY Professor, Division of Perceptual Studies, Department of Psychiatry and Neurobehavioral Sciences, School of Medicine, University of Virginia, Charlottesville, USA. Co-director of Ray Westphal Neuroimaging Laboratory. Scientific interests: neuroimaging studies of exceptional psi subjects and psi-conducive states of consciousness, and both scientific and philosophical theories of consciousness and mind/brain relations.

MORTEN KRINGELBACH Professor of Neuroscience, Universities of Oxford, UK, and Aarhus, Denmark. Founding Director of Centre for Eudaimonia and Human Flourishing, Linacre College. His research uses advanced analysis methods on precise paradigms in healthy people, as well as in at-risk and diseased populations. Scientific interests: reverse-engineer the human brain to elucidate the heuristics that allow us to survive and flourish.

TODD LUBART Professor of Psychology, University Paris Cité, France. Serves on the editorial board of several journals concerning creativity and innovation, received the Berlyne award (American Psychological Association), the NAGC Torrance Award, and was a junior member of the Institut Universitaire de France. President of the International Society for the Study of Creativity and Innovation. Scientific interests: measures of creative potential; environmental support for creativity using virtual reality; development of creativity through game play and the use of generative AI for creativity.

PENOUSAL MACHADO Associate Professor, Department of Informatics Engineering, University of Coimbra, and coordinator of the Cognitive and Media Systems group of CISUC, Portugal. President of SPECIES (Society for the Promotion of Evolutionary Computation). Author of more than 200 refereed journals and conference papers and recipient of several scientific awards, his work was presented in venues such as the National Museum of Contemporary Art and MoMA, NY, USA. Scientific interests: artificial intelligence; evolutionary computation; computational creativity; information visualization.

TIAGO MARTINS Assistant Professor, University of Coimbra, Portugal. Cross-media designer and researcher of the Computational Design and Visualization lab (CDV), a multidisciplinary research laboratory of the Cognitive and Media Systems Group (CMS) of the Centre of Informatics and Systems of the University of Coimbra (CISUC). Scientific interests: Generative Design and Art, Evolutionary Computation,

Computational Creativity.

LUCIA MELLONI Head of the Neural Circuits, Consciousness, and Cognition Research Group, Max Planck Institute for Empirical Aesthetics, Frankfurt, Germany, and Research Professor, Department of Neurology, NYU Grossman School of Medicine, USA. Scientific interests: understanding the neural underpinnings of how we see (perception), how and why we experience what we see (consciousness), and how those experiences become imprinted in our brain (learning and memory), as well as the interplay between these processes.

SERGIO NEUENSCHWANDER Full Professor, Brain Institute, Federal University of Rio Grande do Norte, Natal, Brazil. Scientific interests: neuronal mechanisms of visual perception; role of cortical dynamics in perceptual organization; information transfer in the retinogeniculate system.

MARCUS DU SAUTOY Simonyi Professor for the Public Understanding of Science and Professor of Mathematics, University of Oxford, UK. Author of eight books and two plays, he has presented numerous radio and TV series including "The Story of Maths" for BBC. He works extensively with a range of arts organisations bringing science alive for the public. Scientific interests: understanding the world of symmetry using zeta functions, a classical tool from number theory.

MARILYN SCHLITZ Professor of Transpersonal Psychology, Sofia University, Bulgaria, and CEO/President Emeritus and Senior Fellow, Institute of Noetic Sciences, USA. Social scientist, award-winning author, filmmaker, and dynamic public speaker. She has published several books and hundreds of articles in scholarly journals and popular publications, and has lectured in diverse venues across the world, including the United Nations. Scientific interests: clinical, laboratory, and field-based research into consciousness, human transformation, and healing.

STEFAN SCHMIDT Professor of Systemic Family Therapy and Head of the Academic Section of Systemic Health Research, Department of Psychosomatic Medicine and Psychotherapy, University Medical Centre, Freiburg, Germany. Scientific interests: systems approaches in health research, psychophysiology, consciousness research, mindfulness meditation, experimental parapsychology, exceptional experiences and placebo research.

CHRISTINE SIMMONDS-MOORE Professor of Psychology, Psychology program, Department of Anthropology, Psychology and Sociology, University of West Georgia, USA. Director of the Exceptional Experiences Research Lab [EERL]. Scientific interests: exceptional experiences (ExE); paranormal beliefs and disbeliefs; individual difference

correlates of ExE (including positive schizotypy, transliminality, synesthesia, ASMR, and interoception); mental health correlates of ExE; altered states of consciousness.

MÁRIO SIMÕES Retired Professor of Psychiatry and Consciousness Sciences, Faculty of Medicine of Lisbon, Portugal. Scientific interests: psychology and psychophysiology of altered states of consciousness; ethnomedicine; human exceptional experiences and psychology and spirituality.

NUNO SOUSA Professor at the School of Medicine, University of Minho. Director of the Clinical Academic Center (2CA) - Braga and Researcher at ICVS, University of Minho, Braga, Portugal. Scientific interests: neurobiology of stress and brain network plasticity.

CAROLINE WATT Holder of the Koestler Chair of Parapsychology, and founder member of the Koestler Parapsychology Unit, Psychology Department, University of Edinburgh, Scotland. Scientific interests: testing the psi hypothesis using the ganzfeld method; replication and methodological issues in parapsychology.

Posters com resultados finais apresentados pelos investigadores apoiados pela Fundação BIAL

Posters with final results presented by the BIAL Foundation grant holders

2016

76/16 – "Unleashing the hidden powers of the mind through manipulating belief in cognitive enhancement devices" – only abstract available

Researchers: Michiel van Elk, Uffe Schjoedt, Marcel Brass
Institutions: Department of Psychology, University of Amsterdam (The Netherlands); School of Culture and Society - Department of the Study of Religion, University of Arhus (Denmark)
Duration: 2017/03 – 2022/10

Background: Despite the availability of different cognitive enhancement techniques (e.g., brain stimulation; microdosing with psychedelics; neurofeedback), the efficacy of these techniques has been contested and it is unclear to what extent effects can be attributed to placebo- and expectancy-effects.

Aims: This project investigated whether people can be induced to experience cognitive enhancement by using different placebo-induction procedures.

Method: We presented participants with a sham brain stimulation device (Study 1 & 2A and 2B) or with a placebo cognitive enhancement pill (Study 3), allegedly capable to improve their performance. We used verbal suggestion to induce expectations about the effects (all studies), a performance conditioning procedure (Study 2A), a false feedback conditioning procedure (Study 2B) and a subjective experience conditioning procedure (Study 3).

Results: In all studies we found that participants' subjective experience and performance was in line with the induced expectations. However, we did not observe an effect on objective performance (e.g., on EEG measures in association with error-detection or on creativity) in any of the studies. Highly suggestible participants overall experienced the strongest improvement in subjective performance.

Conclusions: Expectations about cognitive improvement induced through cognitive enhancement devices can induce effects of subjective experience. Future studies on cognitive enhancement techniques should aim to measure participants' expectations, use more ecologically valid tasks and measures and include individual difference measures related to suggestibility and belief in neuromyths.

Keywords: Placebo-effects, Cognitive enhancement, Brain stimulation, Microdosing

Publications:

van Elk, M., Groenendijk, E., & Hoogeveen, S. (2020). Placebo brain stimulation affects subjective but not neurocognitive measures of error processing. *Journal of Cognitive Enhancement*, *4*, 389-400. https://doi.org/10.1007/s41465-020-00172-6

van Elk, M. (2019). Socio-cognitive biases are associated to belief in neuromyths and cognitive enhancement: A pre-registered study. *Personality and Individual Differences*, *147*, 28-32. https://doi.org/10.1016/j.paid.2019.04.014

Maij, D. L., & van Elk, M. (2018). Getting absorbed in experimentally induced extraordinary experiences: Effects of placebo brain stimulation on agency detection. *Consciousness and Cognition*, *66*, 1-16. https://doi.org/10.1016/j.concog.2018.09.010

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206/16 – "Developing a neurofunctional intervention for emotion regulation under stress"
Researchers: Pedro Morgado, Carles Soriano Mas, Paulo Marques, Pedro Moreira, Ricardo Magalhães
Institutions: Life and Health Sciences Research Institute - ICVS, School of Health Sciences, University of Minho, Braga (Portugal); Department of Psychiatry, Bellvitge Biomedical Research Institute - IDIBELL, Barcelona (Spain)
Duration: 2017/01 – 2023/01

Background: Stress may influence emotional behavior, cognition, and decision-making. In addition, the brain regions responsible for decision-making are sensitive to stress-induced changes. Thus, chronic stress may disrupt the ability to cognitively regulate choices. On contrary, neuromodulation strategies can successfully increase neural activity in prefrontal-parietal regions, which will help in increasing cognitive reappraisal capacities. We intended to explore the effects of chronic stress on cognitive regulation of decision making and to develop a neurofunctional intervention protocol using Functional magnetic resonance imaging (fMRI)- Electroencephalography (EEG)- neurofeedback (NFB) to regulate the levels of stress.

Aims: (1) To study the impact of chronic stress on cognitive regulation of decisions using an fMRI task. (2) To develop a neurofunctional intervention protocol based on the combined use of fMRI- and EEG-NFB for increasing cognitive reappraisal capacities in subjects with different levels of perceived stress.

Method: *Task 1.* We used a fMRI task where control (n=14) and chronically stressed (n=15) students had to cognitively upregulate or downregulate their craving before placing a bid to obtain food. The task consisted of two parts: a pre-scan rating task that provided us with a measure of the baseline value for food, and an in-scan bidding and regulation task that measured the food value under the influence of regulation. Stress, anxiety and depression symptoms were measured. *Task 2.* The protocol (n=16) consists of a combined fMRI and EEG acquisition, including a resting state; a localizer cognitive reappraisal task; NFB runs; and another resting-state. During the cognitive reappraisal task, images are shown for the conditions 'observe' (neutral images), 'experience' (negative images, letting their feelings flow), and 'regulate' (negative images to be regulated). During the NFB runs, when they successfully regulate their emotions (increasing prefronto-parietal network activation), the image slowly disappears.

Results: *Task 1.* The stress group revealed higher levels of perceived stress. No statistically significant differences were found for BAI and BDI between groups. Stressed participants placed lower bids to get the reward and chose less frequently higher bid values for food. Nevertheless, we did not find neural and behavioral differences during cognitive regulation of craving. We found a main effect of the cognitive regulation condition in the left hemisphere in the superior and middle temporal gyrus, the rolandic operculum, and the precentral gyrus. *Task 2.* After NFB training we found increased functional connectivity within the salience network (middle/inferior frontal and precentral gyrus). These connectivity values were negatively correlated with the effort self-reported during NFB (Spearman r = -0.834, p = 0.008).

Conclusions: Our results revealed that chronic stress impacts decision-making after cognitive regulation of craving by reducing the valuation of food rewards but not cognitive modulation itself. We also described a technique to successfully regulate cognitive stress appraisal.

Keywords: Stress, Decision-making, Emotion regulation

Publications:
Ferreira, S., Pêgo, J. M., & Morgado, P. (2019). The efficacy of biofeedback approaches for obsessive-compulsive and related disorders: A systematic review and meta-analysis. *Psychiatry Research*, *272*, 237–245. https://doi.org/10.1016/j.psychres.2018.12.096

Morgado, P., & Cerqueira, J. J. (2018). Editorial: The impact of stress on cognition and motivation. *Frontiers in Behavioral Neuroscience*, *12*, 326. https://doi.org/10.3389/fnbeh.2018.00326

Ferreira, S., Veiga, C., Moreira, P., Magalhães, R., Coelho, A., Marques, P., … Morgado, P. (2019). Reduced hedonic valuation of rewards and unaffected cognitive regulation in chronic stress. *Frontiers in Neuroscience*, *13*. https://doi.org/10.3389/fnins.2019.00724

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249/16 – "Healthy aging and economic decision-making: Neuropsychophysiological examination of the affect-integration-motivation framework of decision-making in aging brain"

Researchers: João Marques-Teixeira, Rui Mata, Isabel Martins, Giuseppe Danese, Ana Gonçalves, Carina Fernandes, Rita Pasion
Institution: Laboratory of Neuropsychophysiology, Faculty of Psychology and Education Sciences of the University of Porto (Portugal)
Duration: 2018/02 – 2023/04

Background: According to the Affect–Integration–Motivation (AIM) framework, decisions are preceded by affective, integrative, and motivational processes. Affect potentiate gain/loss anticipation, being integrated with further evaluative considerations. Finally, motivation processes promote subsequent responses of approach/avoidance. Some of these processes are affected by aging, as older adults have preserved gain but reduced loss anticipation and value integration.

Aims: This study aimed to identify age differences in neural correlates of the AIM processes. To this purpose, younger and older adults performed the Monetary Incentive Delay (MID) task adapted to event-related potentials.

Method: During the MID task, a cue signals possible gains/losses and is followed by a target detection to win/avoid losses. Thus, the cue elicits anticipatory affective processes, which are integrated with further considerations to influence motivation processes that promote the target detection. Data was recorded from 77 participants (20–80 years old) to analyse the Cue-P3 (affective processes), Contingent Negative Variation (CNV; integration processes) and the Target-P3 (motivation processes). For younger adults (YA), we hypothesized larger amplitudes for gain/loss compared to neutral trials. For older adults (OA), we hypothesized larger amplitudes for gain than neutral trials, but similar amplitudes between loss and neutral trials.

Results: For YA, cues anticipating gain (p = .004) and loss trials (p <.001) elicited larger Cue-P3 than cues anticipating neutral trials. For OA, cues anticipating gains elicited larger Cue-P3 than cues anticipating neutral trials (p = .012), but cues anticipating loss and neutral trials elicited similar amplitudes (p = .197). Moreover, cues of gain (p <.001) and loss trials (p = .019) elicited larger CNV than cues anticipating neutral trials for YA. For OA, the three conditions elicited similar amplitudes (both ps > 0.572). Finally, targets of gain and loss trials elicited larger Target-P3 than neutral trials, both for YA (both ps <.001) and OA (both ps = .006).

Conclusions: The results support the AIM framework, suggesting that aging alters affective and integration processes. However, according to the results of the Target-P3, aging may preserve motivation processes, including the capacity to differentiate between gain/loss targets (that will result in a monetary gain/loss) from those that will result in neutral feedback.

Keywords: Aging, decision-making, Event-related potentials, Reward anticipation, Feedback processing

Publications:

Fernandes, C., Macedo, I., Gonçalves, A. R., Pasion, R., Mata, R., Danese, G., ... & Marques-Teixeira, J. (2022). Neurophysiological examination of the Affect–Integratio–Motivation framework of decision-making in the aging brain: A registered report. *NeuroImage*, *256*, 119189. https://doi.org/10.1016/j.neuroimage.2022.119189

Fernandes, C., Macedo, I., Gonçalves, A. R., Pereira, M. R., Ferreira-Santos, F., Barbosa, F., & Marques-Teixeira, J. (2023). Effects of aging on face processing: An ERP study of the own-age bias with neutral and emotional faces. *Cortex*, *161*, 13–25. https://doi.org/10.1016/j.cortex.2023.01.007

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280/16 – "Probing the unconscious mind with instrumental hypnosis"
Researchers: Mathieu Landry, Jérôme Sackur, Amir Raz
Institutions: Laboratoire de Sciences Cognitives et Psycholinguistique, École Normale Supérieure, Paris (France); Raz Cognitive Neuroscience Lab, McGill University, Montreal (Canada)
Duration: 2018/06 – 2023/11

Background: The ability for hypnotic responding is marked by inter-individual differences in the population, while the neural underpinning of this variability remains elusive.

Aims: The current work leveraged multivariate statistics and machine learning to probe the neural dynamics underlying hypnotic susceptibility differences.

Method: We assessed the efficacy of linear classifiers in distinguishing between high and low hypnotic susceptibility using neural features from resting-state electroencephalography (EEG) both pre- and post-hypnotic induction. Grounded in prior EEG studies on hypnotic phenomena, our focus encompassed both aperiodic and periodic components of the power spectrum, and graph theoretical measures derived from connectivity patterns.

Results: Several neural features from both pre- and post-induction significantly differentiated susceptibility levels, which underscores the complex dynamics of hypnotic phenomena. Based on model comparisons and feature ranking, we discerned the pre-induction slope of the power spectrum's aperiodic component as the primary discriminating neural feature.

Conclusions: This novel finding not only resonates with the increasing emphasis on this neural component in broader EEG research but also promotes the idea that the primary neural distinction in hypnotic susceptibility is evident at baseline, even before hypnosis. Our findings support the idea that hypnotic susceptibility might be an inherent trait reflected in the aperiodic component of the EEG signal.

Keywords: Hypnosis, Hypnotic susceptibility, Electroencephalography, Machine learning, Multivariate pattern classification

Publications:
Landry, M., da Silva Castanheira, J., Milton, D., & Raz, A. (2022). Suggestion alters Stroop automaticity: Hypnotic alexia through a proactive lens. *Psychology of Consciousness: Theory, Research, and Practice*, *9*(2), 159.
Landry, M., da Silva Castanheira, J., Sackur, J., & Raz, A. (2021). Difficult turned easy: Suggestion renders a challenging visual task simple. *Psychological Science*, *32*(1), 39-49.
Landry, M., Stendel, M., Landry, M., & Raz, A. (2018). Hypnosis in palliative care: from clinical insights to the science of self-regulation. *Annals of Palliative Medicine, 7*(1), 125-135.

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292/16 – "Oxytocin: On the psychophysiology of trust and cooperation"
Researchers: Diana Prata, James Rilling, Manuel Lopes, Duarte Ferreira, Daniel Martins, Pedro Levy
Institutions: FCiências.ID – Associação para a Investigação e Desenvolvimento de Ciências (Portugal); Emory University, Atlanta (USA)
Duration: 2017/10 – 2023/11

Background: Trust is a mentalizing process which makes human relationships, social organizations and political and economical systems, possible. Oxytocin (OT) is a neuromodulator well known to facilitate maternal and pair bonding. Consistently, in humans, exogenous intranasal OT enhances mentalizing that facilitates trusting behaviours: from the affective-perceptual, e.g. facial emotion recognition, eye-to-eye gaze, to a higher-order cognitive-evaluative dimension, e.g., social learning, generosity, cooperation and particularly, trust. However, the underlying psychophysiology of OT's effects is unknown.

Aims: We aimed to understand how oxytocin affect the psychophysiology of cognitive processes behind trust, such as empathy, cooperation and social salience. This research is key to advance social psychology and neuroscience and to rationally improve our etiological models of psychiatric social symptoms.

Method: For this, we have conducted, in humans, a series of studies involving placebo-controlled double blind administration of intranasal oxytocin during a reinforcement learning and salience task, a social dilemma (including with sexual objectification targets), and emotional video viewing (including in people with psychosis) with brain imaging, pupillometry, eye-gaze tracking and/or electroencephalography recording.

Results: This project has allowed us to show that:
1. OT's effects on neural activity may exist irrespective of fear-related social- or reward-contexts;
2. Sexualization impairs cooperative behavior towards women opponents and that this pattern – as well as the associated P300 ERP latency - is counteracted by intranasal oxytocin;
3. Oxytocin's effect on central and autonomic neurocorrelates of salience attribution (as measured via pupillometry and eye-gaze) depend on both socialness and reward value of stimuli;
4. Oxytocin increases the spatio-temporal salience of social interactions measured via eye-gaze during free-viewing;
5. Oxytocin normalizes the synchronization of brain activity across individuals with psychotic disorders during emotional video viewing.

Conclusions: We have thus furthered the characterization of OT's role in both autonomous and central neurocorrelates of cognitive and emotional empathy and social salience attribution – both in healthy and psychosis; and in the context of sexual objectification.

Keywords: Empathy, Trust, Cooperation, Salience, EEG, fMRI, Pupillometry, Eye-gaze

Publications:
Santiago, A. F., Kosilo, M., Cogoni, C., Diogo, V., Jerónimo, R., & Prata, D. (2024). Oxytocin modulates neural activity during early perceptual salience attribution. *Psychoneuroendocrinology, 161,* 106950. https://doi.org/10.1016/j.psyneuen.2023.106950
Cogoni C, Cosme, G, Patrocínio M, Kosilo M, Prata, D. Intranasal oxytocin suppresses negative consequences of sexual objectification: a pharmaco-electroencephalography study. Under review.

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2018

37/18 – "Decoding the neuron-astrocyte dialogue that supports cognitive processing"
Researchers: João Filipe Oliveira, Luísa Pinto, Diana Nascimento, Sónia Gomes, Inês Caetano, João Viana, João Luís Machado, Daniela Sofia Abreu, Sara Barsanti
Institution: Life and Health Sciences Research Institute - ICVS, Universidade do Minho, Braga (Portugal)
Estimated duration: 2019/03 – 2024/04

Background: We and others showed previously that astrocytic modulation of neuronal activity affects the network activity and consequent output production. Astrocytes are active players in brain circuits, sensing and responding to neuronal activity, impacting behavior production. Activation of astrocytes triggers intracellular calcium elevations displaying complex spatiotemporal properties. Intracellular calcium activity is thought to underlie synaptic transmission, metabolism, and brain homeostasis modulation. However, the calcium-dependent signaling pathways involved in these processes are poorly understood, representing a critical knowledge gap in this field.

Aims: The main research objective of this project is to dissect the cellular mechanisms by which astrocytes influence cognitive function processed by cortico-limbic circuits.

Method: We tested mouse models that lack astrocytic signaling signaling to assess its role in cortico-limbic circuits. To assess the influence of these mechanisms to cognitive function, we used complementary state-of-the-art techniques such as *in vivo* electrophysiology, innovative behavior, structural and molecular analysis, to characterize and monitor cognitive function.

Results: The transcriptomic analysis of hippocampal tissue revealed that the lack of astrocytic somatic calcium causes the differential expression of hundreds of genes. Among these, 76 genes are regulated by the astrocyte-specific Foxo1 transcription factor. This transcription factor is over-expressed in the hippocampal astrocytes of this mouse model and regulates the expression of genes involved in spinogenesis and synaptic coverage. A detailed morphological analysis of hippocampal pyramidal neurons revealed dendrites with a shift to a more immature spine profile. This spine profile shift may underlie a previously described reduction of long-term depression and performance in fear memory tasks observed in this mouse model. Indeed, we confirmed that these mice lacking astrocytic somatic calcium display an enhancement of long-term memory. To verify a causal relationship between these structural, synaptic, and behavioral observations, we used a viral approach to induce the over-expression of Foxo1 in hippocampal astrocytes in naïve C57BL/6J mice. This viral-driven over-expression of Foxo1 in astrocytes of the *stratum radiatum* replicated the shift to an immature spine profile in dendrites of pyramidal neurons crossing the territory of these astrocytes and led to a reduction of long-term depression in the same region. Finally, this manipulation was sufficient to enhance long-term memory.

Conclusions: The detailed characterization of the mouse model lacking astrocytic somatic calcium revealed that astrocytes modulate hippocampal circuit structure and function through Foxo1 signaling to enhance long-term memory.

Keywords: Cortico-limbic, Memory mechanism, Astrocyte

Publications:

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67/18 – "Electrophysiological correlates of size-distance integration"
Researcher: Irene Sperandio, Louis Renoult
Institution: Department of Psychology and Cognitive Science, University of Trento, Rovereto (Italy)
Estimated duration: 2020/11 – 2024/04

Background: As we watch a train depart from a platform at a railway station, the size of its image on the retina gets smaller as it moves further away from us. Although the train is shrinking on our retina, we perceive it as exactly the same size, but just moving further from us. This perceptual rescaling of size to counteract the natural shrinkage of an object's retinal image with increasing distance is known as size constancy. Size constancy is critical not only to our perceptual experience, but also to our successful interactions with the physical and social world. Yet, our understanding of when and where the complex integration between size and distance information takes place remains unknown.

Aims: By combining EEG and kinematic data, we aimed to unveil for the first time when (and where) the human brain achieves size constancy during perceptual and grasping tasks.

Method: We recorded event-related potentials (ERPs) in conjunction with kinematics while participants (N=16) were asked to either manually estimate the perceived size of an object (perceptual task) or to pick it up (grasping task). Small and big disks were placed at near and far distances, respectively, in order to subtend the same visual angle on the retina in one study. In another study, viewing distance was manipulated indirectly by means of visual illusions: a small disk was presented either in the upper or lower part of a Ponzo display. Participants (N=16) were asked to maintain their gaze steadily on a fixation point throughout the experiment. Meanwhile, EEG was recorded from a 64-scalp electrodes system and their hand was tracked with a motion capture system.

Results: We found earlier latencies and greater amplitudes in response to perceptually bigger than smaller objects of matched retinal size, regardless of the task. In line with the ERP results, manual estimates and peak grip apertures were larger for objects that were perceived as bigger. We also found task-related differences at later stages of processing from a cluster of central electrodes, whereby the mean amplitude of the P2 component was greater for manual estimation than grasping.

Conclusions: These findings provide novel evidence that size constancy for real objects occurs at the earliest cortical stages and that early visual processing does not change as a function of task demands.

Keywords: size-distance scaling; grip constancy; size estimation; EEG; kinematics

Publications:
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68/18 – "Investigating biochemical mechanisms underlying mind-matter interactions: Effect of intention on human stem cell properties via cryptochrome"

Researchers: Yung-Jong Shiah, George T.-J. Huang
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Duration: 2019/03 – 2023/03

Background: This study investigates the idea that some forms of mind-matter interactions (MMI) may be associated with energetic properties that can influence distant living systems.

Aim: This study explored if human primary mesenchymal stem cells (MSCs), derived from two donors and cultivated in a medium made with intentionally treated water, would exhibit more growth and pluripotency than MSCs from the same source but grown in untreated (control) water.

Method: To create the treated water, three Buddhist monks directed their attention toward commercially bottled water while holding the intention that the water would enhance the growth of MSCs. Under double-blind conditions, cell culture growth mediums were prepared with the treated and untreated water, which was in turn used to grow the primary MSCs. Primary cells obtained from two donors were designated as Cells #1 and Cells #2. The prediction was that treated water would result in increased cell proliferation, that more cells would enter the cell cycle growth phase, and that there would be increased expression of genes (*NANOG, OCT4* and *SOX2*) associated with improved cell growth and decreased expression of genes (*p16*, *p21*, and *p53*) associated with a decline in cell growth. The improved growth hypothesis was directional, thus one-tailed *p*-values were used to evaluate the results.

Results: Proliferation averaged across Cells #1 and #2 showed overall increased growth in treated as compared to control water ($p = 0.0008$). Cells #1 and #2 considered separately had differences in the same direction but only Cells #2 showed a significant difference on day 6 ($p = 0.01$). For cell cycle, there was a significantly greater percentage of Cells #2 in the S interphase with treated vs. control water ($p = 0.04$). For the gene expression analysis, when considering the average across the two donor cells, only the *NANOG* gene expression was in the predicted direction ($p = 0.01$); by contrast, the *p16* gene expression was significantly opposite to the predicted direction ($p = 0.005$, one-tailed, post-hoc). For Cells #1 considered separately, no differences were significant except for *p16*, which resulted in an effect opposite to the predicted outcome ($p = 0.05$). For Cells #2, three genes were significantly in the predicted directions: *NANOG* ($p = 0.0008$), *OCT4* ($p = 0.005$), and *P53* ($p = 0.05$); *p16* was significantly opposite to the prediction ($p = 0.001$).

Conclusion: Intentionally treated water appeared to have some biological effects on the growth, pluripotency and senescence of human MSCs. This was especially the case in one of the two donor cells tested, but the effects were not consistently in the predicted direction. As an exploratory study, caution is warranted in interpreting these outcomes, and adjustment for multiple testing would likely reduce some of the weaker effects to nonsignificant. But given the double-blind protocol, as well as several more significant outcomes in the predicted directions, further research is warranted.

Keywords: Intention, Mind-matter interaction, Water, Stem cells, Pluripotent genes, Senescence genes, *NANOG, OCT4, p16, p21, p53*

Publication:

Shiah, Y. J., Shan, L., Radin, D. I., & Huang, G. T. (2022). Effects of intentionally treated water on the growth of mesenchymal stem cells: An exploratory study. Explore: The *Journal of Science & Healing, 18*(6), 663-669. doi.1016/j.explore.2021.11.007

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81/18 – "Meditation as a first-person method in the neuroscience of consciousness: A comparison of the informativeness and reliability of first person data collected from meditators and non-meditators in a novel Libet paradigm"

Researchers: Stefan Schmidt, Sebastian Kübel, Marc Wittmann, Han-Gue Jo
Institution: Department of Psychosomatic Medicine and Psychotherapy, University Medical Center Freiburg (Germany)
Estimated duration: 2020/11 – 2024/04

Background: In the Libet task, participants are asked to voluntarily press a button at a time of their own choice and to report subsequently the moment when they made the decision to act while their EEG is recorded. The action-related readiness potential (RP) found in the EEG usually starts before the decision time. We have argued earlier that this time paradox can be explained by the process of backward sampling EEG data and by participants having a higher probability of pressing the button during certain phases of the continuously fluctuating slow cortical potentials (SCP). Related to this hypothesis is the assumption that the 'urge to act' reported by participants corresponds to a negativity in the SCP signal.

Aim: The aim of our investigation was to study the experiential contents of experienced meditators during positive and negative deflections of the readiness potential prior to voluntary movements. Furthermore, we aimed at classifying the blinded reports according to their phenomenological content into two distinct patterns that can be in turn correctly linked to either positive or negative deflections of the EEG.

Methods: We performed a modified version of the Libet experiment with experienced meditators (N=17) to study this hypothesis. Based on real-time EEG analysis the task was stopped once a trial occurred during a clear negative or clear positive SCP. We then conducted a microphenomenological interview. With the help of this special interview technique, the precise experiential dynamics characterizing the decision moment were recalled and examined, resulting in a rich phenomenological description.

Results: Diachronic analysis of the interviews revealed two distinct patterns: one in which an impulse to press the button was felt yet not acted out, before a second impulse was felt and acted upon. In the other pattern only one impulse was felt and acted upon. Based on the blinded analysis of the phenomenological reports, trials were classified as belonging to one of two different categories, i.e. positive or negative SCP. This was correct in 10 out of 17 trials (p=0.31).

Conclusion: Our approach shows how in a neurophenomenological approach EEG data and phenomenological first-person data can be integrated in a systematic and meaningful way. Meditation can serve as a research method in the sense that meditators are able to provide detailed introspective descriptions on volitional processes.

Keywords: Libet-task, Neurophenomenology, Microphenomenological interview, Slow cortical potentials, Readiness potential

Publications:

Schmidt, S.; Bauer, P.R.; & Trautwein, F.-M. (under review) Neurophenomenology in Action: Integrating the First-Person Perspective into the Libet Experiment. *Mindfulness*.

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85/18 – "Role of NT3/TrkC in the regulation of fear"
Researcher: Mónica Santos
Institution: Center for Neuroscience and Cell Biology, University of Coimbra (Portugal)
Duration: 2019/03 – 2023/07

Background: Maladaptive fear is a cardinal feature of many anxiety disorders, often manifested as excessive/inappropriate learned fear and resistance to extinction. The efficacy of behavioral therapies depends on interindividual variation in fear extinction, for which the neurobiological basis is unknown. Fear learning and extinction rely on synaptic plasticity events occurring at a fear network comprising the amygdala, hippocampus, and medial prefrontal cortex. Neurotrophins, known regulators of synaptic plasticity, present as obvious candidates for the regulation of fear processes.

Aims: To investigate the role of neurotrophin 3 (NT3)/Tropomyosin receptor kinase C (TrkC) in the fear network in the regulation of learned fear and extinction.

Methods: Mice trained in contextual fear conditioning and extinction paradigm were used to (i) isolate amygdala synaptoneurosomes (n=8 per group) and perform immunofluorescence assays to study synaptic receptors; (ii) perform *ex-vivo* electrophysiological recordings and pharmacological treatments to study amygdalar synaptic plasticity (n=3-6 per group); (iii) measure TrkC activation in the brain fear network by western blots (n=7-14 per group). Stereotaxic surgeries and local infusions of NT3 in the amygdala (n=6 per group) were performed in combination with behavioral experiments.

Results: We established a model to study interindividual differences in fear extinction. Fear conditioned mice were categorized as extinction (EXT)-success or EXT-failure, according to their inherent ability to extinguish fear. Statistical analysis revealed significant differences when the two groups were compared: EXT-success mice showed attenuated LTP, robust LTD and higher levels of synaptic GluN2B, while EXT-failure mice showed strong LTP, no LTD and higher levels of synaptic GluN2A. Moreover, an inactivation of TrkC overall in the fear network was observed during consolidation and reconsolidation, while an increased TrkC activation was observed at extinction consolidation in the amygdalae of EXT-success, as compared to EXT-failure mice. Scavenging endogenous NT3 with TrkC-Fc in EXT-success slices strengthened LA LTP. In EXT-failure mice, NT3 perfusion attenuated LA LTP, in a GluN2B-dependent manner, and NT3 infusion in the LA was sufficient to rescue extinction deficits.

Conclusions: Our data support a key role for the NT3-TrkC system in interindividual differences in fear extinction in mice, through modulation of amygdalar NMDAR composition and synaptic plasticity.

Keywords: Neurotrophins, Anxiety, Fear extinction, NMDA receptors, Synaptic plasticity

Publications:
Silva, F., Masella, G., Madeira, M. F., Duarte, C. B., & Santos, M. (2023). TrkC Intracellular Signalling in the Brain Fear Network During the Formation of a Contextual Fear Memory. *Molecular Neurobiology*, 60(6), 3507–3521. https://doi.org/10.1007/s12035-023-03292-0

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89/18 – "National survey of "Cases of Reincarnation Type" in Brazil"

Researchers: Alexander Moreira-Almeida, Jim Tucker, Lucam Moraes, Sandra Carvalho
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Estimated duration: 2019/04 – 2024/04

Background: Almost all the academic investigation of claimed past-life memories (CPLM) has involved children. However little is known about the profile and impact of CPLM on adults.

Aims: To investigate the profile of Brazilian CORT; the content of the CPLM and their influence on subject/family lives; the accuracy of children's CPLM; and the levels of religiosity/spirituality (R/S), happiness, and mental health and their associations with CPLM.

Method: Brazilians (no age limits) from all over the country were recruited through intense mass media announcements to answer an online questionnaire that included sociodemographics; CPLM features; and R/S, health, and happiness scales. We conducted in person detailed interviews with first-hand witnesses in children´s cases, as well as documental analysis to verify associations between the CPLM and facts of the deceased individual's life. We used Bardin's content analysis of CPLM and descriptive and inferential statistical analysis.

Results: The final sample is composed of 426 participants, 94% adults and 6% children/adolescents. Most children are male (62%) and adults are female (79%). Most memories occurred spontaneously (82% adults; 92% children). Typical CORT features in adults and children's samples: birthmarks (54%, 29%); unlearned skills (48%, 33%); phobias (71%, 17%); philias (30%, 21%). Among adults, most were spiritists (55%); the highest R/S dimension was "Values/Beliefs" 3.0 (±1.06) and the lowest was "Private Religious Practices" 18.7 (±6.98). 46% of the participants were above the cut-off point for Common Mental Disorders (CMD) and 39% for Post-Traumatic Stress Disorder (PTSD). Philias predicted lower happiness OR 0.33 (CI 0.19-0.54) and higher CMD symptoms OR 3.99 (2.34-6.99). Phobias were associated with CMD OR 2.60 (1.51-4.57) and PTSD symptoms OR 1.79 (1.07-3.05) Content analysis of memories of adults revealed ordinary past lives, but with intense and traumatic suffering. Memories influenced the subject/family (48%), and in 44% of those in a negative way. 1778 minutes of interviews were performed with first-hand witnesses. One strong child case was associated with a birth defect determined by a head computed tomography scan.

Conclusions: This first national CORT survey enlarges the understating of adult cases. CPLM among adults seem not uncommon and can be associated with considerable distress and suffering, a relevant issue in clinical practice. We point to the need for more studies about prevalence, impact and proper clinical management.

Keywords: Life after death, Reincarnation, Past-life memories, Children, Mental health

Publications:

Moraes, L. J., & Moreira-Almeida, A. (2020). A comprehensive academic review of reincarnation research. *Journal of Parapsychology, 84*(2), 311-315. https://doi.org/10.30891/jopar.2020.02.13

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110/18 – "A randomized trial: Extraordinary experiences and performance on psi tasks related to meditation"

Researchers: Jennifer Kim Penberthy, Marieta Pehlivanova, Elizabeth Hanchak, Leslie Hubbard
Institution: Division of Perceptual Studies - DOPS, School of Medicine, University of Virginia, Charlottesville (USA)
Duration: 2020/05 – 2024/01

Background: We explored wellbeing, mindfulness, paranormal beliefs and experiences between meditators and exercisers.

Aims: Compare listed variables and psi task in meditation vs exercise cohorts over time.

Method: Subjects were randomized by a generated random allocation sequence to cohort. Data obtained online with IRB approval at baseline, week 4, 9, and 2 months. Multivariate regression models used for outcomes, combining mid, and follow-up measures for each score using the cohort groups as the unique independent variable. For the psi and paranormal experiences, we conducted unique multivariate regression model with all outcomes at post 1 using the cohort groups as the sole independent variable. Self-reported paranormal beliefs and experiences variables were compared at follow-up using linear probability regression models with standard errors robust to heteroscedasticity. STATA 15 was used for statistical analysis. RNG data was analyzed using Matlab functions to calculate a total number of bits, percent deviation, cumulated Z scores for the time interval, and max Z score.

Results: 72 subjects (N = 45 meditation/N = 27 exercise) showed no significant differences between groups in wellbeing over time with both improving. Significant increases in meditators acting with awareness at the end of the study ($p < 0.001$, CI 95% -5.85; -1.90) and at two month follow up ($p < 0.001$, CI 95% -5.88; -2.02), compared to exercise cohort. No differences between groups in sense of closeness, connectedness, self-transcendence. Meditation cohort reported more out of body experiences (p=0.008), spontaneous healing ($p = 0.003$), seeing energy fields ($p = 0.032$), contact with distant others ($p = 0.039$), directing healing energy ($p = 0.021$), and other paranormal experiences ($p < 0.001$). Meditators vs exercisers reported: hearing things ($p < 0.001$) and tasting things ($p < 0.001$) that were not physically present; altered sense of space ($p < 0.001$) and identity ($p < 0.001$); disturbing feelings ($p < 0.001$); sense of collective energy ($p < 0.001$); awareness of a nonphysical entity ($p < 0.001$); telekinesis ($p < 0.001$); and clairvoyance ($p < 0.001$). Exercise cohort endorsed altered breathing more than the meditation cohort ($p = 0.003$). RNG did not show any residual deviations during any of the post-test data acquisitions at the $p = 0.05$ level.

Conclusions: Both groups improved in wellbeing. Meditation group demonstrated significant increases in aspects of mindfulness, paranormal experiences, and beliefs vs exercise cohort. Performance on psi task did not improve in either group over time, as these tasks may not be sensitive enough to detect changes. Limitations/biases of the study include the small sample of predominately non-Hispanic white females, and unequal groups that occurred.

Keywords: Meditation, Mindfulness, Paranormal experiences, Psi beliefs

Publications:

Penberthy, J.K., Garcia Claro, H., Kalelioglu, T., Centeno, C., Ladoni, A., Ragone, E., Rowley, C., Hanchak, E. (2023). The impact of meditation versus exercise on psychological characteristics, paranormal experiences, and beliefs: Randomized trial. *Journal of Scientific Exploration*.

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135/18 – "The physiological role of circadian rhythms in memory"
Researchers: Luísa Lopes, Miguel Remondes, Ana Morgado, Joana Coelho
Institution: Instituto de Medicina Molecular - João Lobo Antunes, Lisboa (Portugal)
Duration: 2019/01 – 2023/01

Background: Circadian disruption impacts on cognition as seen in shift-work and manipulation of sleep-wake cycles in humans and rats (Marquié et al, 2015; Fekete et al, 1985). However, the functional interactions between Suprachiasmatic Nucleus (SCN) and memory-related regions, such as the Hippocampus (HIPP), have never been defined.

Aims: Explore the functional alterations of brain regions related to memory, upon circadian insult in a rodent model.

Method: Whole-brain functional connectivity was modeled by combining ^{14}C-2-deoxyglucose functional imaging and Partial Least Square Regression (Dawson et al, 2014) on male rats (13 week-old) under a normal circadian cycle or after 4 cycles of repeated phase shifts and recovery sessions (Craig et al, 2008).

Results: Upon analysis of 67 brain regions, we found alterations in the metabolic activity of SCN and the HIPP, Medial Entorhinal Cortex, Perirhinal Cortex and Dorsal Raphé. We then modeled the relationship between the activity of these seed regions and the remainder regions measured. A total of 127 functional connectivity interactions were impacted by the circadian shift, suggesting a disruption of HIPP-cortical communication with strong remodelling of the connections between cognitive regions. Moreover, the shifted animals displayed reduced performance in the Novel Object Recognition Test, whereas the performances in the Morris Water Maze and the Y-maze were preserved. Trans-synaptic antero- and retrograde tracing using viral vectors also suggested a role of theta rhythm in the interaction between circadian rhythms and cognition. We found anatomical projections between the SCN and the HIPP with a relay in the Septum, that may act as a hub of circadian information onto the hippocampal system.

Conclusions: Altogether, these results indicate a pronounced change in dominant functional circuits after circadian insult. These altered patterns of connectivity suggest an adaptation to a different type of HIPP-cortical communication, from a process dependent on theta oscillations to a form of interaction not mediated by theta rhythm. Further analysis is ongoing to validate this hypothesis.

Keywords: Circadian, Memory, Hippocampus, Cognition

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148/18 – "Voice perception in the visually deprived brain: Behavioral and electrophysiological insights"

Researchers: Tatiana Conde e Magro, Ana Pinheiro, César Lima, João Sarzedas
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Duration: 2020/02 – 2023/09

Background: The ability to infer emotion and identity information from the voice is a relevant social skill. Although blind listeners need to rely more strongly on vocal cues alone to successfully interact with their social environment, the mechanisms of voice perception and its neural underpinnings remain poorly understood.

Aims: This Project investigated: 1) whether blindness modulated the perception of vocal emotion and identity information; 2) whether the age of blindness onset affected vocal emotion and identity perception mechanisms.

Method: Behavioural and event-related potential (ERP) measures of voice emotion and identity perception were collected in blind and sighted participants. The ERP analyses focused on the N1, P2, and late positive potential (LPP). Behavioural and ERP data analyses were conducted using linear mixed-effects models.

Results: Our ERP findings in voice emotion perception revealed that only early-blind listeners were sensitive to crying authenticity at the N1 (all p's < .001) and middle LPP (all p's < .001) time windows, and to laughter authenticity at the early LPP (all p's < .001) time window. Moreover, early-blind and sighted listeners were more sensitive than late-blind ones to crying authenticity at the P2 (all p's < .001) and late LPP (all p's < .001) time windows. All groups were sensitive to laughter authenticity at the P2 time window (lowest p = .016), and to crying authenticity at the early LPP time window (lowest p = .015). Behaviourally, early-blind and sighted participants performed similarly well in emotional authenticity perception (p > .999), but the late-blind group performed worse than sighted controls (p < .001). Our ERP results in voice identity perception showed that identity effects were stronger in the early blind group (vs. sighted) at the N1 (lowest p = .008) and N400 stages (lowest p < .001). Furthermore, identity modulations at the P2, early LPP, and late LPP time windows were observed in both early blind and sighted groups, but sighted listeners were more sensitive than early blind to self- (at P2; p < .001) and familiar identity (at early LPP; p < .001). Behaviourally, there were no group differences in identity recognition (p = .619).

Conclusions: Together, these studies suggest that neural mechanisms of voice perception develop differently in cases of early blindness.

Keywords: Vocal emotion, Emotional authenticity, Vocal identity, Blindness, Neuroplasticity

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156/18 – "Examining observer effects on random processes: A correlation matrix" – only abstract available

Researcher: Ana Flores
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Duration: 2019/07 – 2024/02

Background: The study investigates the interaction between mind and matter, exploring correlations between psychological behaviour and a physical system. Psychological data, acquired during task performance, and physical variables from a random number generator are combined into matrices for joint analysis. The Correlation Matrix Method (CMM) is a promising approach used to assess predictions from the Model of Pragmatic Information. Previous research employing this method has shown favourable outcomes, aligning with the Model's principles. CMM investigates the correlation between psychological and physical systems, to shed light on the interaction between mind and matter.

Aims: The research aims to examine the statistical distribution of matrices generated in experimental sessions compared to control sessions.

Method: A new experimental setup was employed, involving an online game designed for touchscreen devices. This study involved 726 participants from over 50 countries in 10,964 sessions. Participants' interactions, recorded as finger swipes, served as psychological variables. The study included experimental and control sessions conducted on participants' devices. Two RNGs, Random.org and Mersenne Twister, were used to investigate the effects of generated randomness.

Results: The analysis of each RNG's data showed statistically significant differences for Random.org, unlike Mersenne Twister, which showed no significant variations. The findings support the replication of CMM using Random.org.

Conclusions: The possibility of participant influence the RNG, despite their blindness, needs to be addressed in future studies. Implementing stricter control measures and additional blinding mechanisms could help address this potential confound.

Keywords: Mind and mater, Random number generator, Correlation matrix, Online game

Publications:
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169/18 – "Temporal decoding of selective recollection with psychophysiology"
Researchers: Alexa Morcom, Arjen Alink
Institution: School of Psychology, University of Sussex (UK)
Duration: 2019/06 – 2022/05

Background: Our brains store memories of a vast number of past experiences. To guide behavior effectively we use external cues and strategic control to select which memories will be retrieved. Electroencephalography (EEG) provides time-resolved measures of the underlying neural processes, and we can neural signatures of recollection when people retrieve goal-relevant versus irrelevant memories. Here, we combined established and novel electrophysiological measures to understand selective memory retrieval.

Aims: We used multivariate decoding of scalp-recorded EEG patterns and the left parietal event-related potential (ERP) effect to investigate the neural dynamics of selective recollection, the impact of external memory cues and the goal representations proposed to enable memory selection.

Method: In two EEG experiments, people studied objects in two sources: a picture or auditory word format [1]. At test, one source at a time was targeted, using either written words (Experiment 1, $N = 28$) or line drawings (Experiment 2, $N = 28$) as external cues. We used a multivariate classifier to quantify reinstatement of study phase neural patterns when people successfully identified targets or non-targeted items. If recollection is selective, ERPs and reinstated neural patterns would be more pronounced for targets.

Results: The two EEG measures revealed distinct patterns of selectivity from 500-800 ms post-stimulus. The left parietal ERP was larger for targets than non-targets only when retrieval cues overlapped strongly with the targeted source (auditory words in Experiment 1, and pictures in Experiment 2; interaction $F(1, 54) = 38.04$, $p < 0.001$, $\eta^2_p = 0.413$). In contrast, neural pattern reinstatement was selective for whichever source overlapped more with the external cues [2], whether this was the targeted or the non-targeted format (robust $t(32) = 3.00$, $p = .010$, $\xi = 0.490$ and $t(32) = -2.71$, $p = .011$, $\xi = 0.356$). In both experiments ERPs also revealed goal-directed control, with preparatory reinstatement of targeted neural patterns in Experiment 1 as predicted by the encoding specificity principle (cluster $p = .006, .023$).

Conclusions: The data suggest that selection depends on both external cues and internal, goal-directed control. While neural pattern reinstatement tracked external cue overlap with stored memories, the left parietal ERP tracked both goals and cue overlap, suggesting that downstream processing may modulate initial neural reinstatement, in line with goals.

Keywords: Episodic memory, ERP, EEG, Multivariate decoding, Selective retrieval

Publications:
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188/18 – "COping with PAin through Hypnosis, mindfulness and Spirituality (COPAHS)"

Researchers: Maria Alexandra Ferreira Valente, José Luís Pais Ribeiro, Mark Philip Jensen, Ana Filipa Pimenta, Rui Miguel Costa, Melissa Day
Institutions: William James Center for Research, ISPA – Instituto Universitário, Lisboa (Portugal); Department of Rehabilitation Medicine, University of Washington, Seattle (USA)
Duration: 2019/10 – 2023/01

Background: Hypnosis, mindfulness meditation, and prayer have been shown to be effective as strategies to self-management chronic pain, but their effects on acute pain have been less studied. No prior research compared, in a head-to-head study, the immediate effects, and mechanisms (mediators and moderators) of these three self-management approaches on pain-related outcomes. This study shought to fill this knowledge gap.

Aims: Compare, in the same study, the immediate effects, as well as the unique and shared predictors, and treatment-specific enhance moderators of the effects, of hypnosis (HYP), mindfulness meditation (MM), and a biblical-based meditation prayer (MP) on cold pressor outcomes.

Method: The study protocol was pre-registered at the ClinicalTrials.gov registry (NCT04491630). A sample of 232 healthy adults were randomly assigned to the MM, the HYP, the MP, or an attention control (CN) condition. Participants underwent a pre- and a post-intervention cycle of Cold Pressor Arm Wrap (CPAW). The 20-min single sessions of MM, HYP, MP, or CN, were audio-delivered. Individuals were assessed for pain intensity immediately after each CPAW cycle. Pain tolerance (sec) was evaluated during the CPAW cycles. HRV was evaluated at baseline, and during the CPAW cycles. Post-hoc pairwise comparisons used Bonferroni adjusted α's.

Results: Relative to within-group comparisons, from the pre- to the post-test, (1) small decreases in pain intensity, (2) small increases in pain tolerance, and (3) small improvements in the LH/HF ratio, were observed. In regard to the exploratory between-group pairwise effect sizes comparisons (1) medium effect size (d = .66) effects of HYP on pain tolerance as compared to the CN, and (2) small positive (d = .28), yet non-statistically significant (*ns*), effects of CP relative to CN, were found. Small to medium *ns* Time X Group interaction effects were found ($.025 < \eta^2_p < .077$). The effects of HYP were predicted/moderated by outcome expectations, hypnotizability, and religious denomination; those of MM were predicted/moderated by spirituality and religiosity; and those of MP were predicted/moderated by outcome expectations, and mindfulness trait.

Conclusions: These findings suggest that single short-term session of HYP and MM, but not MP, may be useful self-management strategies for acute pain, with HYP being a slightly superior option, especially for those individuals with higher hypnotizability, and with greater HYP-related outcome expectations.

Keywords: Acute pain, Self-management, Cold pressor, Hypnosis, Meditation

Publications:

Ferreira-Valente, A., Jarego, M., Queiroz-Garcia, I., Pimenta, F., Costa, R. M., Day, M. A., Pais-Ribeiro, J., & Jensen, M. P. (2021). Prayer as a pain intervention: Protocol of a systematic review of randomised controlled trials. *BMJ Open*, *11*(7), e047580. https://doi.org/10.1136/bmjopen-2020-047580

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198/18 – "Sense of agency in the Ouija board experience" – only abstract available
Researchers: Gethin Hughes, Peter Gooding
Institution: Department of Psychology, University of Essex (UK)
Estimated duration: 2019/04 – 2024/04

Background: For over 100 years, the Ouija board has been used as a way to communicate with spirits. Players hold a heart shaped "planchette" over a board marked with letters and numbers, while taking turns to ask questions. Although players control the movement of the planchette themselves, they experience reduced sense of agency, and therefore attribute the movements to spirits.

Aims: The first experiment aimed to investigate the neural correlates of sense of agency in the Ouija board game. The second experiment assessed the role of physiological arousal in the sense of agency during Ouija board use.

Method: Participants were paired with a confederate, with the two players holding a wooden planchette attached to a single computer mouse that was used to navigate around a computerised Ouija board. In study 1, the colour that they landed on determined whether a sound was played or not. In study 2, different colours were associated with different possibility of reward. Agency was manipulated by having the confederate contribute more to the movements of the planchette in some conditions. Sense of agency was measured by asking participants to report how much control they had over the outcome (study 1) or their action (study 2). In study 1 we also recorded EEG data to measure N1(70-130ms at FCz), P2 (160-190ms at Cz), and P3 (270-330ms) ERP components. In study 2 we measured heart rate deceleration and electrodermal activity.

Results: We found no modulation of N1 dependent on the degree to which participants had agency over the planchette. However, later (P2 and P3) components were increased for self-agency conditions. In experiment 2, we found increased agency ratings when participants landed on risky quadrants in the Ouija task. Increased physiological arousal was associated with greater sense of agency.

Conclusions: Findings from Study 1 show that sense of agency in the Ouija board task is not modulated by sensory differences (sensory attenuation/suppression), that have previously been associated with agency processing. Findings from study 2 suggest that sense of agency in the Ouija board task is modulated by risk-related physiological arousal.

Keywords: Agency, EEG, Arousal, Risk, Joint action

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204/18 – "Boosting WM capacity by strengthening the oscillatory functional fronto-parietal pathway"

Researcher: Vincenzo Romei
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Duration: 2019/03 – 2023/04

Background: Oscillatory brain activity serves long-range networks communication including the fronto-parietal network, involved in cognitive control functions such as working memory (WM).

Aims: Here we implemented and validated for the first time a novel information-based Transcranial Magnetic Stimulation (TMS) protocol to selectively enhance frequency-tuned long-range communication within the fronto-parietal network and impact WM performance in a frequency specific fashion.

Method: A paired TMS protocol, namely, frequency-tuned cortico-cortical paired associative stimulation (ccPAS), was applied to the right frontal and parietal nodes of the fronto-parietal network, to induce Hebbian-like plasticity to 180 healthy volunteers. In four groups (30 participants each), the stimulation could follow a fronto-parietal or a parieto-frontal direction with an interpulse interval set to a timing corresponding to the duration of each individual alpha (8-14Hz) or theta (4-7Hz) oscillatory peak. As a control, one group (N=30) received no stimulation (sham) while another group (N=30) received simultaneous stimulation unable to induce Hebbian plasticity. Electroencephalographic (EEG) fronto-parietal functional connectivity was measured before and after ccPAS, both during resting state and WM performance.

Results: EEG results showed enhanced fronto-parietal alpha-band connectivity following fronto-parietal alpha-tuned-ccPAS, both at rest and during task execution, but not following the opposite parieto-frontal direction or sham. This effect was frequency specific as no modulation was observed for control frequency bands, i.e., theta. Conversely, we found no effect after theta-tuned ccPAS, independently of the stimulation direction. Lastly, no effect was found after simultaneous stimulation. At the behavioural level, fronto-parietal alpha-tuned ccPAS induced an enhanced performance for visual stimuli ipsilateral to the stimulation site, compared to sham. Performance of all the other groups did not significantly differ from sham.

Conclusions: Here we demonstrated that alpha-tuned timing and direction of stimulation are critical in modulating long-range alpha-phase coherence between the stimulated areas. Furthermore, we provide direct evidence of oscillatory functional relevance. Specifically, we show the causal involvement of alpha rhythms in the top-down suppression of irrelevant items with a concurrent release of resources to facilitate memorization of the relevant ones.

Keywords: Working memory, Brain oscillations, Electroencephalography, Transcranial magnetic stimulation, Functional connectivity

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210/18 – "Mind-matter interactions and the frontal lobes of the brain"

Researchers: Morris Freedman, Robert Chen, Malcolm Binns
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Duration: 2019/07 – 2023/11

Background: While psi is a subject of intense debate, it is reasonable to postulate that putative effects involving these phenomena must involve the brain. Building on this premise, we devised a novel neurobiological model of psi which posits that the frontal lobes of the brain act as a filter to inhibit psi. In support of this model, our initial studies showed significant psi effects as measured by mind-matter interactions in individuals with brain damage in the left medial middle frontal lobe involving Brodmann areas 9, 10, and 32. However, our data were based on only 2 cases.

Aims: To determine, using rTMS, whether the left medial middle frontal region of the brain acts as a filter to inhibit psi as measured by mind-matter interactions.

Method: We studied 3 groups of healthy participants (n=36 per group; total 108): rTMS induced lesions in left medial middle frontal region, rTMS induced lesions in right medial middle frontal region, and sham stimulation. A protocol of rTMS, known as continuous theta burst stimulation (cTBS), was used to reduce cortical excitability with an effect lasting about 20 to 30 minutes. cTBS was delivered to the left or right medial middle frontal region, targeting Brodmann areas 9, 10, and 32. The experimental task was to influence the numerical output of a portable Random Event Generator. The output was translated into movement of an arrow on a computer screen to the right or left. Participants were asked to concentrate on moving the arrow to the right or left. The arrow pointed in the direction that they were asked to move it. The arrow tip started at the midline.

Results: In support of our *a priori* hypothesis, we found significant psi effects following rTMS inhibition of the left medial middle frontal lobe compared to sham stimulation when participants tried to move the arrow on the computer screen to the right [$\hat{\beta}$ = -0.17, 95% CI: (-0.29, -0.05), t = -2.80, p = 0.006, d = 0.38]. *$\hat{\beta}$= parameter estimate; d = Cohen's d (effect size).

Conclusions: Our study marks the *third replication* by our research team and suggests that the left medial middle frontal region of the brain acts as a filter to inhibit psi. Our results also suggest that individuals with left frontal lesions may represent an enriched sample for detection and replication of psi effects. The implications of our work have the potential to reshape our understanding of the relation between the brain and seemingly random events.

Keywords: Frontal lobes, Mind-matter interactions, Repetitive transcranial magnetic stimulation, Psi, Parapsychology

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220/18 – "Mind-shaped body: A new conceptual framework beyond the placebo effect connecting expectations to disease outcome"

Researchers: Francesco Pagnini, Paolo Banfi, Cesare Cavalera, Eleonora Volpato
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Duration: 2019/02 – 2022/03

Background: Placebo and nocebo effects can promote physical modifications by creating an expectation of change through a primer, such as a fake pill. Every person who receives a diagnosis develops their expectations about the course of the disease, known as "Illness Expectation" (IE). This cognitive schema defines future-oriented beliefs about the illness and symptoms of individuals with chronic diseases, which can be both explicit and implicit and characterized by different degrees of rigidity.

Aims: This study aims to test the hypothesis that IEs affect illness symptoms in asthma.

Method: The study employed a repeated measures design. Three hundred twelve participants with asthma were assessed three times over six months for asthma symptoms (using the Asthma Control Test), respiratory values (using FEV1 measured by spirometer), and illness expectations, using the previously validated "Illness Expectation Test," which assesses both explicit and implicit expectations. The predictive values of illness expectations on asthma symptoms and respiratory parameters were measured using latent growth modeling and linear regressions.

Results: Longitudinal data analysis suggests a strong predictive value of explicit expectations on self-reported asthma symptoms (β = -0.50, se = 0.21, p = 0.01). Implicit expectations showed a non-statistically significant similar trend (β = -0.014, se = 0.008, p = 0.09). Furthermore, expectations of improvement or worsening of symptoms over time strongly predicted changes in respiratory values (β = 0.51, se = 0.11, p = 0.001).

Conclusions: These results confirm the relevance of illness expectations in asthma progression and suggest a high potential for mind/body interventions.

Keywords: Illness expectations, Placebo, Mind-body, Asthma

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252/18 – "Spiritual states induced by ayahuasca, and the involvement of the reward system"
Researchers: Miguel Castelo-Branco, Gisela Lima, Miguel Raimundo, Pedro Fonseca, Carla Cavaleiro, Lorena Petrella, Célia Cabral, Antero Abrunhosa
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Duration: 2019/10 – 2022/09

Background: DMT is an indole alkaloid best known by its presence in ayahuasca. It is a psychedelic tryptamine associated with intense visual phenomena, perception changes and profound spiritual experiences.

Aims: In this study we explored the neural correlates of these altered brain states during the experience produced by DMT using resting state fMRI and periodic visual stimuli.

Method: A within-subject design study with control and active treatment conditions was conducted, in 2 separate sessions: Control (no treatment) or Active treatment (inhaled DMT, unblinded). In both sessions, pre and post measures of subjective experience were collected with the Spiritual Well Being Questionnaire, the Vividness of Visual Imagery Questionnaire, the Mystical Experience Questionnaire (MEQ-30) and the Hallucinogen Rating Scale (HRS). fMRI included resting state, block design with a visual hallucination inducer paradigm, and visual population receptive field (pRF) mapping.

Results: Significant perceptual and psychological effects were observed for hallucinogen and mystical subjective experiences (HRS: Active vs Control, repeated-measures ANOVA: $F(1,8) = 50.07$, $p\text{-value} < 0.01$). Changes in connectivity patterns were found within functionally segregated regions of the Default Mode, Salience, and Reward networks. Mean pRF size in V1 was statistically significantly higher in the DMT condition ($F(3, 54) = 22.6790$, $p\text{-value} < 0.001$, with large effect size of regression with eccentricity: $R2 = 0{,}94$). Visual stimulation, yielded increased BOLD activity in visual areas BA18, 19 and Precuneus for the active condition. This may explain perceptual distortions induced by psychedelics such as field blurring and the enlargement of nearby visual space, particularly at the visual periphery.

Conclusions: These results suggest a neural basis for the hallucinations and phenomenological experiences evoked by Ayahuasca which occur concomitantly with significant behavioural and psychological effects.

Keywords: Cognition, Functional magnetic resonance imaging, Psychedelic agents, Serotonin, Spiritual states, Hallucinations

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Soares, C., Gonzalo, G., Castelhano, J., & Castelo-Branco, M. (2023). The relationship between the default mode network and the theory of mind network as revealed by psychedelics - A meta-analysis. *Neuroscience and Biobehavioral Reviews*, *152*, 105325. https://doi.org/10.1016/j.neubiorev.2023.105325

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287/18 – "More thankful, less stressed? Gratitude and physiological reactions to stress"

Researchers: Brenda O'Connell, Stephen Gallagher, Brian Leavy
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Duration: 2019/09 – 2023/10

Background: Psychophysiological scholars have explored the role of psychosocial factors, like positive affect and social support, in buffering against pathogenic effects of stress. Of these, gratitude has recently been associated with the cardiovascular stress response. However, previous research has been predominantly cross-sectional in nature.

Aims: This study investigates the effects of a gratitude intervention on cardiovascular responses to stress using a randomised-control trial design.

Method: A convenience sample of 129 participants underwent a laboratory-based stress task while their systolic blood pressure, diastolic blood pressure, and heart rate were measured. Participants were randomly assigned to either a gratitude letter intervention or an active control condition.

Results: Results of mixed between-within ANOVAs revealed no significant time by intervention interaction for diastolic blood pressure ($F(1, 109) = 1.234$, $p = .269$), or heart rate ($F(1, 109) = 1.964$, $p = .164$). However, there was a significant time by intervention interaction for systolic blood pressure ($F(1, 120) = 4.573$, $p = .035$), demonstrating that the pattern of increase for systolic blood pressure differed by experimental condition.

Conclusions: These findings provide support for the hypothesis that gratitude may have a beneficial relationship with cardiovascular responses to stress. Future research should replicate and extend these findings with larger and more diverse samples and a longer intervention period, assess additional cardiovascular parameters, and explore long-term relationships between gratitude, cardiovascular reactivity, and health outcomes.

Keywords: Gratitude, Cardiovascular, Stress, Reactivity

Publications:

Leavy, B., O'Connell, B. & O'Shea, D. (2023). Gratitude, affect balance and stress buffering: A growth curve examination of cardiovascular responses to a laboratory stress task. *International Journal of Psychophysiology, 183,* 103-116. https://doi.org/10.1016/j.ijpsycho.2022.11.013

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296/18 – "The power of mind: Altering cutaneous sensations by autosuggestion"
Researchers: Elena Azáñon, Esther Kuehn, Kasia Myga
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Duration: 2019/11 – 2023/11

Background: Autosuggestion is one form of self-suggestion and follows the idea that the constant, inner repetition of a thought, can actively influence the way we perceive. This concept is nowadays used in many life and job coaching concepts, however, empirical evidence on how far and to what extent autosuggestion can indeed alter one's own perception is so far scarce.

Aims: In this project, we used psychophysics and electrophysiological recordings, to answer the question of how the inner repetition of an idea influences perception, emotion and body representation.

Method: In Study 1, we used an implict measurement, taking advantage of a known interaction between intensity and frequency perception in touch. We asked participants to modulate the perceived intensity of vibrotactile stimuli at the fingertip through the inner reiteration of the thought that this perception feels very strong or weak, while they were asked to report the perceived frequency. In Study 2, we compared electrophysiological responses to touch in a placebo condition and during autosuggestion that a touch feels stronger. For the placebo cream, we told participants that the cream produces an increase in the strength of tactile sensations. In Study 4, we asked participants to autosuggest or imagine, in two separate conditions, that an emotional-neutral face looks happy or sad, and measured adaptation aftereffects to the exposure to those autosuggested or imagined (in reality neutral) faces. Finally, in Study 4, we asked participants to autosuggest that a pair of uncrossed realistic rubber hands were their own, and test the effects of this manipulation on the ordering of two touches applied to their real crossed hands, aiming at reducing the crossed hands deficit.

Results: Using an implicit measure, we observed that after reiteration of the words "this touch feels stronger" or "weaker" participants perceived that touch as stronger or weaker than in the baseline condition (Study 1). Similarly, we observed an effect on the perceived emotional facial expression after suggesting that a preceding neutral face was happy or sad (Study 2). The effects of imagery and autosuggestion did not differ from each other. We are currently analysing Studies 2 and 4.

Conclusions: Our studies provide first experimental demonstrations that the inner reiteration of a thought alters participants' tactile perception and visual perception of facial emotion.

Keywords: Autosuggestion, Tactile perception, Placebo, Emotion, Body representation

Publications:
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Myga, K. A., Kuehn, E., & Azañón, E. (2024). How the inner repetition of a desired perception changes actual tactile perception. *Scientific Reports, 14*(1), 3072. https://doi.org/10.1038/s41598-024-53449-7

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306/18 – "The neural circuitry underlying error monitoring during social cognition"

Researchers: Teresa Sousa, Miguel Castelo-Branco, João Castelhano, Verónica Figueiredo, Andreia Pereira
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Duration: 2019/10 – 2022/09

Background: Error monitoring is the metacognitive process by which we detect and signal errors. Although this is a vital function for human adaptive behavior, it remains understudied in social contexts.

Aims: In this research project, we investigated the neural circuitry associated with error monitoring during the integration of social cues to gain insights into its role in social cognition. Our aim was to unravel the neural mechanisms that come into play in situations where error awareness is critical, employing both electroencephalography (EEG) and functional magnetic resonance imaging (fMRI).

Method: Through EEG, we explored the dynamic brain processes related to self-monitoring while anticipating and performing an error. More specifically, we tested how task-specific variables, such as cognitive demand and control, influenced these processes. Subsequently, we employed fMRI to elucidate the contribution of different brain regions to such mechanisms. We conducted two EEG and two fMRI tasks with 40 healthy participants each, during actions based on facial cues integration and implicit error monitoring.

Results: We found opposing midfrontal theta modulation when anticipating and committing an error, regardless of the response type (social or non-social). This suggests midfrontal theta's role in cognitive control during performance monitoring, not just response adaptation. Moreover, our EEG results also showed an advantage in studying error monitoring in complex scenarios, such as social ones, when focusing on frequency-domain components. The fMRI data revealed that the communication between the salience and frontoparietal networks is involved in both explicit and implicit error monitoring. The anterior insular cortex was found to play a crucial role in switching between these networks, supporting the salience network's role as a hub in facilitating interactions between distinct networks during higher-order functions of the human brain.

Conclusions: Our research highlights the utility of midfrontal theta as a robust indicator for studying error monitoring in complex social contexts. It also emphasizes the salience network's role as a crucial hub connecting different neural networks in the process of error monitoring. These results pave the way for future studies exploring error monitoring dynamics in dyadic or peer interactions within genuine social scenarios.

Keywords: Error monitoring, Social cognition, Executive function, fMRI, EEG

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Dias C, Costa D, Sousa T, Castelhano J, Figueiredo V, Pereira A, Castelo-Branco M (2022) A neuronal theta band signature of error monitoring during integration of facial expression cues. PeerJ 10: e12627. http://dx.doi.org/10.7717/peerj.12627

Estiveira J, Dias C, Costa D, Castelhano J, Castelo-Branco M, Sousa T (2021) Reinterpretation of the functional significance of error-related theta signals. *In* Salzburg Mind-Brain Annual Meeting 2021. Online.

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320/18 – "The role of interneurons in spatial memory"

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Estimated duration: 2019/10 – 2024/04

Background: The hippocampus is a brain structure involved in learning and memory. Lesions in the dorsal hippocampus lead to spatial memory deficits, whereas ventral lesions result in anxiety-like behaviors. From the multitude of neuronal cell types, parvalbumin (PV) interneurons have been shown to modulate learning and memory. While the ablation of PV+ cells in dorsal hippocampal CA1 affects spatial working memory in mice, contextual fear learning and maze navigation depends on ventral PV+ cells.

Aims: Since interneurons are master regulators of hippocampal electrophysiological output, they are likely implicated in dorsal and ventral hippocampus differing responses to plasticity paradigms associated with spatial memory. Therefore, we intended to study the role of PV+ cells along the dorsal-ventral longitudinal hippocampal axis.

Method: We performed anti-PV immunohistochemistry in dorsal and ventral hippocampus. We processed samples for proteomic and lipidomic analyses of dorsal and ventral hippocampus to identify the lipidomic determinants of PV-linked proteomic signatures. We optimized hippocampal spatial dependent behaviors by modifying the novel object recognition (NOR) test using two arena sizes: 28x28cm (miniNOR) and 44x44cm (maxiNOR). Animal were tested in 2 trials: short, at 4h after training; and long, at 24h.

Results: PV interneurons density is different along the hippocampal longitudinal axis, with the ventral dentate gyrus showing lower PV+ density. We are currently assessing the differential behavioral impact and so far, we observed that when in a smaller arena, mice perform better when the recall interval is longer (24h vs 4h). However, in a bigger arena, mice are able to recall the familiar object within 4h after object presentation, but not at 24h. We are now assessing task performance correlation with PV-structural metrics and regional hippocampal activation. We have also generated proteo-lipidomic data to identify signatures along the longitudinal hippocampal axis that rely on PV interneurons.

Conclusions: Our results suggest that memory formation can be influenced by the arena size, which relies on differential poles of the hippocampus. Aligned with PV+ multiomic signatures, future experiments manipulating PV-interneurons differentially along the longitudinal hippocampal axis will inform about the impact of these cells on spatial memory paradigms.

Keywords: Hippocampus, Interneurons, Longitudinal axis, Parvalbumin

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331/18 – "Frontostriatal neurophysiological underpins of decision-making"

Researchers: Hugo Leite-Almeida, Madalena Esteves, Marco Rafael Guimarães, Ana Margarida Cunha, Joana Mendes, Armando Almeida
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Estimated duration: 2020/02 – 2024/04

Background: Impulsivity is a central process in decision-making and is typically divided in action impulsivity and choice impulsivity/delay intolerance (preference for smaller but immediate outcomes). These two forms of impulsivity overlap in many aspects, notably at the network level but important differences have been described. For instance, in the variable delay-to-signal (VDS) a behavioral paradigm that captures these two types of impulsive behavior, a challenge with methamphetamine increased action impulsivity but decreased delay tolerance. Also, impulsive action and delay tolerance are mediated by distinct sub-regions of the nucleus accumbens (NAcc), shell and core, respectively.
The frontostriatal network is essential for different decision-making steps. It remains however largely unexplored different network nodes interact to compute a decision and what differs in their activity that eventually culminates in a favorable or unfavorable outcome. In this project we will explore these questions in rats by measuring local field potentials (LFPs) simultaneously in 8 regions – prelimbic cortex (Prl), orbitofrontal cortex (OFC), striatum (Str) and NAcc in both hemispheres – during the execution of the VDS paradigms.

Aims: register the activity of 8 nodes of the rat's frontostriatal network during decision-making; identify decision-specific (timed vs premature) network level signatures.

Method: Ni/Cr single-wire electrodes will be implanted bilaterally for LFP recordings in young adult 2-3 month-old male Wistar han rats in the Prl, OFC, NAcc (core division) and Str (dorsolateral). These areas have been implicated in impulsive decision-making. Regional evoked neuronal activity (LFPs) will be registered during the execution of the VDS task; power analysis and functional coherence between these areas will be analyzed off record. The VDS will be performed in an operant chambers and consists in 2 main phases: training and VDS proper. While in the former delays are fixed (3 seconds) and premature responses (i.e. prior to a light signal) are punished with a timeout period cancelling the ongoing trial, in the latter delays vary from 3 to 12 seconds and nose pokes are allowed during these periods; in this case prematurity rate is defined as the amount of premature responses per minute of total delay.

Results: Three to 2 s before a response, power in the entire left network and the right Nacc show different activation depending on the future response (timed or premature). Immediately after, left Prl- right Nacc coherence seems to play a role, after which left Prl- right Prl and right Prl- right OPFC associations lead to one of the outcomes. After the response, the entire network seems to encode rewarded/unrewarded trials.

Conclusions: Activity in the network studied encondes future actions in an impulsivity task. The PrL is a good target for modulation in future studies.

Keywords: Behavior, Mesocorticolimbic network, Executive function, Impulsivity

Publications:

Esteves, M., Moreira, P.S., Sousa, N., Leite-Almeida, H., 2021. Assessing Impulsivity in Humans and Rodents: Taking the Translational Road. *Frontiers in Behavioral Neuroscience* 15, 647922.
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336/18 – "Research-inspired cognitive empowerment: Modulating Episodic Memory through Egocentric Navigational Training (MEMENT)" – only abstract available

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Duration: 2021/09 – 2023/04

Background: According to the phylogenetic continuity hypothesis (Buzsáki & Moser, 2013), mechanisms supporting declarative memory (episodic-EM and semantic-SM) might have evolved from mechanism of navigation (egocentric-EN and allocentric-AN) in the physical world.

Aims: In a series of studies, using measures of human performance, we tested if traces of this phylogenetic continuity may be observed in human behavior and its neural underpinnings.

Method: We first submitted healthy participants ($N = 60$) to classic versions of EN (path integration) and EM/SM (Study 1), and then stressed the dynamic component of sequential updating of information for EN/EM/SM ($N = 141$) (Study 2). In Study 3 we studied the complete 4-components model by using navigational (EN/route, AN/survey) and memory (EM, SM) tasks based on the same audio-visual material ($N = 74$). To assess a causal relationship between navigation and memory, we employed a navigational vs. control training protocol (Study 4). Finally, we explored the neurophysiological similarities between spatial navigation and memory through EEG (Study 5).

Results: In Study 1 we observed a specific correlation and predictive relationship between EN and EM, but not SM, abilities. In Study 2, we extended the observed association between EN and EM to the dynamic component of sequential updating of information. An indirect relationship was also described between EN and SM mediated by EM. In Study 3, results indicated that route-based navigation specifically predicted EM performance while survey navigation specifically predicted SM performance. In Study 4, the results indicated a significant improvement of EM but not SM or short-term memory following the navigational but not the control training. In Study 5 we found a specific theta band modulation during temporal memory and, on the other side, an alpha and beta band modulation during the spatial and semantic tasks. Of relevance, the shared pattern of alpha/beta strong desynchronization for the processing of spatial and conceptual information support recent frameworks of a spatial representational format for high-level cognition (Bellmund 2018).

Conclusions: The results of the whole granted project provide consistent support to the phylogenetic continuity hypothesis between mechanisms of spatial navigation and declarative memory and offer new insights for application of navigational training programs for memory rehabilitation and empowerment.

Keywords: Spatial navigation, Path integration, Episodic memory, Semantic memory, Cognitive training, Empowerment

Publications:

Committeri, G., Fragueiro, A., Campanile, M. M., Lagatta, M., Burles, F., Iaria, G., Sestieri, C., & Tosoni, A. (2020). Egocentric navigation abilities predict episodic memory performance. *Frontiers in Human Neuroscience*, *14*, 574224. https://doi.org/10.3389/fnhum.2020.574224

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347/18 – "Driving synaptic plasticity in motor-to-visual neural pathways to enhance action prediction"

Researchers: Alessio Avenanti, Marco Zanon
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Duration: 2019/10 – 2023/06

Background: Social interactions heavily depend on the ability to perceive and predict the actions of others. These cognitive processes are supported by an Action Observation Network (AON), characterized by bidirectional connections linking high-order visual areas like the posterior superior temporal sulcus (pSTS) to parieto-frontal motor regions, including the inferior frontal cortex (IFC). Despite the recognized significance of IFC in the AON, the precise nature of its interaction with pSTS for facilitating action perception remains poorly understood.

Aims: This research aims to investigate the plasticity and functional relevance of the IFC-pSTS pathway to action prediction through the application of Transcranial Magnetic Stimulation (TMS).

Method: In the main study, participants engaged in two tasks: an action prediction task (AP), that required predicting the final outcome of a reaching-grasping action from the initial phases of the movement, and a non-biological movement control task. Participants underwent TMS testing via cortico-cortical paired associative stimulation (ccPAS), a protocol designed to induce Hebbian spike-timing-dependent plasticity (STDP) in the IFC-pSTS pathway, thereby strengthening the directional connectivity from IFC to pSTS. Control ccPAS conditions were employed to evaluate pathway- and direction-specific changes in action perception. Additionally, preliminary studies were conducted to establish ccPAS protocols for inducing STDP in the target cortico-cortical networks.

Results: The findings revealed that ccPAS aimed at enhancing IFC-pSTS connectivity led to improved performance in action prediction tasks. No similar improvement was observed in the control task or following control ccPAS conditions.

Conclusions: Our unique approach provides unprecedented causal evidence, highlighting the pivotal role of backward IFC-pSTS connectivity in the ability to predict the outcome of observed actions. These findings deepen our mechanistic understanding of AON functions, shedding light on the malleability and functional relevance of the IFC-pSTS pathway within the AON concerning action prediction. This study provides novel insights into the functional architecture and dynamics of the AON, with significant theoretical and practical implications.

Keywords: Brain plasticity, Transcranial magnetic stimulation, Perception, Action

Publications:

Borgomaneri S, Zanon M, Di Luzio P, Cataneo A, Arcara G, Romei V, Tamietto M, Avenanti A (2023). Increasing associative plasticity in temporo-occipital back-projections improves visual perception of emotions from facial stimuli. *Nature Communications* 14, 5720

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Turrini S, Bevacqua N, Cataneo A, Chiappini E, Fiori F, Candidi M, Avenanti A (2023). Transcranial cortico-cortical paired associative stimulation (ccPAS) over ventral premotor-motor pathways enhances action performance and corticomotor excitability in young adults more than in elderly adults. *Frontiers in Aging Neuroscience* 15, 1119508. DOI: 10.3389/fnagi.2023.1119508

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355/18 – "The implicit cognition of interpersonal attraction"

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Duration: 2019/05 – 2024/02

Background: Research has shown that women's sensitivity to cues for reproductive fitness is enhanced in periods of high fertility. During ovulation, women are faster at recognizing faces as male, and report a greater preference for facial masculinity, height, vocal masculinity, a masculine and muscular body shape, and dominant behavior. Do changes in subjective time for females depend on reproductive hormones, with an increased sensitivity to fitness-related stimuli during ovulation?

Aims: The goal of the present study was to investigate for the first time whether females' duration estimates of brief exposures to masculine faces and voices change during different phases of the menstrual cycle. We hypothesized that during the fertile phase of the cycle, encounters with masculine men, leading to increased arousal, would result in longer perceived durations.

Method: Forty-seven female participants completed the experiment during both ovulation and menstruation. The peak fertility was assessed through ovulation kits. The experiment consisted of 3 blocks: visual attractiveness, visual sexually dimorphic, and auditory sexually dimorphic. In each block, participants performed either a visual or an auditory oddball task. During each trial, participants were presented with a series of five stimuli, all of equal duration. Their task was to reproduce the duration of the last stimulus. The first four stimuli in each trial were either circular sine-wave gratings (visual oddball) or 600 Hz sine waves (auditory oddball), and the last stimulus could be either an identical stimulus, an attractive/unattractive male photo, a masculinized/feminized male facial picture or a masculinized/feminized male voice.

Results: Results confirmed our prediction, but only in the auditory modality. Duration ovulation, duration estimates for masculinized male voices were significantly longer than those for feminized male voices, while no significant differences were observed during menses. Although we replicated previous findings regarding the influence of facial attractiveness on time perception, our data suggests that these effects are not influenced by the hormonal cycle. No differences were found for the visual sexually dimorphic block.
Conclusions: Our findings are consistent with the literature on an adaptative mechanism of our "internal clock" related to reproductive fitness.

Keywords: Time perception, Ovulation, Menstrual cycle, Attractiveness, Sexually dismorphic

Publications:

Arantes, J., Pinho, M., Wearden, J., & Albuquerque, P. B. (2021). "Time slows down whenever you are around" for women but not for men. *Frontiers in Psychology, 12*, 641729. https://doi.org/10.3389/fpsyg.2021.641729

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359/18 – "A Comparison of NN-DMT, Changa & 5-MeO-DMT and the Near-death Experience: Qualitative analyses and reviews of the neuroscience"

Researchers: Pascal Michael, David Luke
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Estimated duration: 2020/01 – 2024/04

Background: The near-death experience (NDE) remains an intriguing phenomenon with various theories attempting to explain it. Psychedelics, with their ability to induce profound alterations in consciousness, have been proposed as potential models for understanding NDEs.

Aims: This doctoral thesis aimed to bridge the gap in research by conducting a systematic comparison of the qualitative content of psychedelics, particularly N,N-DMT and changa, with NDEs. This included analyzing the experiences of individuals who had undergone both psychedelics and NDEs.

Method: The study employed a thematic and content analysis of interviews from a naturalistic field study involving N,N-DMT users. The near-death experience scale (NDES) was also administered to assess the similarity between psychedelic experiences and NDEs. Case studies were conducted on individuals who had experienced 5-MeO-DMT, changa, and NDEs.

Results: The analysis revealed that N,N-DMT consistently induced experiences characterized by entering another realm, meeting entities, and pervasive bodily, sensorial, psychological, and emotional transformations. While there were similarities to NDEs, the sequencing of features and the qualitative nature of content varied. A small subset of DMT experiences closely mirrored NDEs. 5-MeO-DMT experiences generally lacked the diversity of features found in NDEs, except for mystical dimensions. Changa experiences showed varying degrees of similarity to the individuals' own NDEs, with one participant reporting a high similarity and another a lower one. However, none replicated the encounter with deceased individuals seen in some NDEs.

Conclusions: Despite their similarities, the explored drug states only partially replicate certain features of NDEs and fail to generate the same content. Each state holds potential for therapeutic applications and provides insights into the neurobiology of consciousness. The NDE's intersection with psychedelics and the parapsychological components of these states suggest a complex interplay of factors that warrant further investigation. Future research should focus on qualitative comparisons of the after-effects of NDEs and drug states, given their profound impact on individuals' lives.

Keywords: Near-death experience, Psychedelic, DMT, Qualitative analysis, Neuroscience

Publications:

Michael, P. (2020). Neurothanatology: The Quest for the NDE-ogen. *The Paranormal Review*.

Michael, P., Luke, D., & Robinson, O. (2021). An encounter with the other: A thematic and content analysis of DMT experiences from a naturalistic field study. *Frontiers in Psychology*, *12*, 720717. https://doi.org/10.3389/fpsyg.2021.720717

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Michael, P. (2022). Commentary on "After: A doctor explores what near-death experiences reveal about life and beyond" by Bruce Greyson. *Journal of Near-death Studies*, *39*(3), 161. https://doi.org/10.17514/JNDS-2021-39-3-p161-183

Michael, P. (2022). Rejoinder to "Response to Pascal Michael's commentary on After: A doctor explores what near-death experiences reveal about life and beyond". *Journal of Near-Death Studies*, *39*(3), 0891-4494. https://doi.org/10.17514/JNDS-2021-39-3-p195-211

Michael, P., Luke, D., & Robinson, O. (2023). An encounter with the self: A thematic and content analysis of the DMT experience from a naturalistic field study. *Frontiers in Psychology*, *14*, 1083356. https://doi.org/10.3389/fpsyg.2023.1083356

Michael, P., Luke, D., & Robinson, O. (2023). This is your brain on death: a comparative analysis of a near-death experience and subsequent 5-Methoxy-DMT experience. *Frontiers in Psychology*, *14*, 1083361. https://doi.org/10.3389/fpsyg.2023.1083361

Michael, P., Luke, D. (*in press*). Imitations of immortality: Psychedelics as NDE-mimetics and the neuroscience of death and near-death. In Ruickbie, L. (Ed.), Is There Life After Death?

Michael, P., Luke, D., & Robinson, O. (in press). Smokable “vine of the dead”: Two case studies of experiencers of both a changa and near-death experience. The International Journal of Transpersonal Studies, 94.
Michael, P., Luke, D., and Robinson, O. (*under review*). An encounter with death: Comparative thematic analyses of the DMT experience and the near-death experience.

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366/18 – "Transpersonal imagery and bereavement: The psychomanteum and virtual reality"
Researchers: Marilyn Schlitz, Dorote Lucci, Donna Dulo, Kelly Yi, Lincoln Nguyen
Institutions: Institute of Transpersonal Psychology Foundation, Palo Alto, California (USA); Sofia University, Palo Alto, California (USA)
Estimated duration: 2021/05 – 2024/04

Background: Bereavement is a common occurrence for people experiencing loss of loved ones. An innovative approach to transforming grief involves a sensory deprivation procedure known as the psychomanteum, in which participants may have experiences of their departed loved ones based on guided suggestions. Previous research suggests that the psychomanteum is useful for people recovering from grief and that the level of absorption enhances the experience. This has been explored in a physical chamber involving gazing into a reflective surface with intention. This study extended previous research by introducing Virtual Reality, which enhances absorption and veridical experiences. A Continuing Bonds theory offers support for the value of encouraging a felt sense of connection to loved ones for those experiencing loss.

Aims: (1) Evaluate impact of psychomanteum on grief; (2) Examine correlations between absorption on grief: (3) Measure difference in Aims 1 and 2 by comparing the physical chamber and VR on grief and absorption.

Method: Utilize sensory deprivation procedure to evoke experiences of departed loved ones and compare physical chamber and VR by using psychometrics (Tellegen Absorption Scale and Likert Bereavement Scale) and a qualitative thematic analysis of language use before and after the procedure.

Results: Ninety-two participants completed pre and post evaluations. Aim 1 was tested using a paired samples t- test for pre and post measures of grief and found a significant effect ($p < .001$, 2-t). Supporting this, a Persons r was performed to analyze Aim 2; this showed a significant correlation on grief and while absorption was held constant ($p = .019$). For Aim 3, no significant effect was seen between the physical chamber and the VR experiences. This suggests that the experiences are isomorphic and supports the interchangeability of the approaches. Language analysis found that the experiences were profound and transformative for most participants. Results supported the Continuing Bonds Theory. Many people expressed a wish that the session had been longer and that they might come again.

Conclusions: This study offers a highly innovative approach to bereavement and the application of the psychomanteum to health and healing. The transpersonal experiences reported can be transformative and may have powerful potentials for aiding people in their times of suffering. Rather than finding a need to get over the loss, the Continuing Bonds Theory has been shown to be therapeutic. Future research will focus on examining absorption and repeated exposure to the VR experience.

Keywords: Grief, Virtual reality, Consciousness, Psychomanteum, Absorption

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2020

24/20 – "World-relative object motion: How the brain detects object motion while we are moving" – only abstract available
Researcher: Valentina Sulpizio
Institution: IRCCS Fondazione Santa Lucia, Rome (Italy)
Duration: 2021/10 – 2024/01

Background: The ability to detect and assess world-relative object motion is a critical computation performed by the visual system. This computation, however, is greatly complicated by observer motion, which generates a global pattern of motion on the observer's retina. How the visual system implements this computation is poorly understood.

Aims: This study aimed to unveil the potential neural signature of object-motion detection by manipulating relative motion velocity between the observer and the object as a strategy to test how the brain accomplishes this computation.

Method: We used a combined approach of surface-based brain mapping, task-evoked activity by fMRI, and advanced data analysis procedures. In 26 healthy volunteers we first identified a set of egomotion-related visual areas (CSv, pCi, PIC, V6, V3A, VIP and MT+) by using the flow field stimulus. We then examined their response to the main fMRI experiment consisting of observation of movies reproducing different velocities of visually induced translational self- and object-motion within a realistic virtual environment. Repeated-measures ANOVAs were used to test the brain sensitivity to different combinations of self- and object-motion. Parametric and representational similarity (RSA) analyses were used to test whether the activity of these regions was modulated by self- and object-motion velocity.

Results: We found that, among all the egomotion areas, CSv and V6 showed a remarkable preference for pure self-motion with respect to pure object-motion and to any combination of self- and object-motion. Results from parametric and RSA analyses revealed that areas MT+, V6+, and V3A also showed a response profile reflecting different object-motion velocities.

Conclusions: A differentiated profile emerged among the egomotion regions during a visual motion stimulation including self- and object-displacements and a combination of them. Areas MT+, V6, and V3A showed a response profile reflecting different self- and object-motion velocities. Notably, "real motion" detection has been ascribed to the monkey areas MT+, V6, and V3A, since they host a good percentage of "real-motion" cells, i.e., neurons responding to the actual movement of an object in the visual field, but not to the movement of its retinal image self-induced by self-motion. We suggest that these regions may be involved in the critical computational process needed to detect scene-relative object motion during visually induced self-motion.

Keywords: Optic flow, Object-motion, Self-motion, Functional magnetic resonance, Egomotion, Neural similarity

Publications:
Sulpizio, V., von Gal, A., Galati, G., Fattori, P., Galletti, C., & Pitzalis, S. (2024). Neural sensitivity to translational self- and object-motion velocities. *Human Brain Mapping, 45*(1), e26571. https://doi.org/10.1002/hbm.26571

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26/20 – "Anticipation and experience of stressful situations and their psychobiological impact on providing pre-hospital emergency medicine care"

Researchers: Mark Wetherell, Jeff Doran
Institutions: Department of Psychology, Northumbria University Newcastle (UK); Great North Air Ambulance Service (UK)
Estimated duration: 2021/09 – 2024/04

Background: Individuals who provide critical emergency care mount rapid psychobiological responses when faced with an incident. These responses are adaptive and ensure resources at time of demand; however, frequent activation with minimal opportunity for recovery can have negative consequences for health and wellbeing. Monitoring individuals engaging in real emergency situations would provide an understanding of their stress responses during critical care; however, this presents significant logistical challenges and could compromise patient care. A viable alternative is to assess individuals during high-fidelity training scenarios. This study is the first to assess the impact of pre-hospital emergency medicine training on multiple psychobiological stress indices. Moreover, the study represents the largest, most comprehensive assessment of psychobiological stress indices during an extended period of high-fidelity simulation.

Aims: To understand the impact of high-fidelity emergency medicine training on psychobiological indices related to health and wellbeing.

Method: In a sample of doctors and paramedics (N=27), psychological (state, cognitive and somatic anxiety; stress and worry, perceived demands and control) and biological (diurnal cortisol; continuous heart rate and a heart rate variability [HRV] derived stress index) measures were recorded throughout 10 days of training and a weekend of no activities. Training involved the acquisition of human factors, non-technical and surgical skills, and the application of these skills in complex high-fidelity scenarios including road-traffic accidents, firearms incidents, and swift water rescues.

Results: All measures of psychobiological responding during training were distinct from the weekend and characterised by statistically significant increases in anxiety, stress and worry, elevated heart rate, HRV-derived stress, and diurnal cortisol secretion. The highest levels of psychobiological responding occurred on days characterised by greater perceived demand and lower perceived control of the day's events.

Conclusions: Patterns of higher psychobiological responding and lower control were most evident on the days comprising the application of skills in complex multiple scenarios. Given the high-fidelity of these scenarios, this study gives unique insight into stress responding and recovery in pre-hospital emergency medicine and could be used to identify patterns of responding that impact upon health and wellbeing.

Keywords: Stress, Emergency medicine, Cortisol, Heartrate, High-fidelity training

Publications:

Wetherell, M.A., Doran, J, (2023). Assessing stress responding and recovery during high-fidelity training in pre-hospital emergency medicine. *Proceedings of the Stress, Trauma, Anxiety, Research Society,* Faro.

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73/20 – "Cerebrovascular hypothesis of stress-induced behavioral alterations"

Researchers: Ana Paula Silva, Filipa Baptista, Ana Rita Gaspar, Ricardo Leitão, Catarina Gomes
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Estimated duration: 2021/09 – 2024/09

Background: Recent studies have suggested that stress is linked with cerebrovascular diseases, particularly with blood-brain barrier (BBB) dysfunction. Noteworthy, the complement pathway plays an important role in innate immunity, and BBB dysfunction can occur with dysregulation of the complement However, little is known about the mechanisms underlying stress-induced BBB alterations, the putative role of the complement pathway, and sex-specific alterations.

Aims: This study aimed to assess the possible involvement of BBB dysfunction in stress-induced behavioural alterations, with a focus on the C3 complement pathway. Sex-dependent alterations were also explored.

Method: Male and female adult Wistar rats were subjected to a 6h restraint protocol (acute stress) or to unpredictable chronic mild stress (uCMS) protocol for 6 weeks (chronic stress). The effect of each stress paradigm on anxiety, memory and depressive-like behavior was assessed. Then, blood was collected and pre-frontal cortex (PFC) isolated for molecular studies. The impact of stress on the BBB was examined by quantifying the levels of claudin-5, β-catenin, vascular cell adhesion molecule-1 and albumin in the PFC. The complement C3 and C3a receptor protein levels were also evaluated.

Results: Stress protocols did not induce an anxiety-like behavior, or memory impairments in both sexes. Also, females did not present a depressive-like phenotype when evaluated in the forced swimming test. However, male rats exposed to uCMS spent more time immobile, portraying a helpless behavior, a core symptom of depression, whereas male rats exposed to acute stress exhibited an escape-directed behavior with an increase in the time spent swimming. Regarding BBB properties, exposure to uCMS or acute stress increased claudin-5 protein levels in the PFC of female or male rats, respectively. Following uCMS, no changes were found in C3 and C3aR levels in the PFC in both sexes. Nevertheless, a significant decrease in C3aR in male rats exposed to acute stress was identified.

Conclusions: Males seem to be more affected at the behavior level, while females cope better and eventually develop a stress-resilient phenotype. Increased levels of claudin-5 in the PFC have been associated with resilience phenotype, which may explain female resilient phenotype upon uCMS, and with better adaptive responses in males upon acute stress. Decreased C3aR levels might be also linked with a more resilient and adaptative phenotype upon stress.

Keywords: Stress, Blood-brain barrier, Sex differences, Complement component 3

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79/20 – "Redefining the boundaries between cognition and action through the psychophysiological investigation of binary decisions"

*Researcher*s: Michele Scaltritti, Simone Sulpizio
Institutions: Department of Psychology and Cognitive Science, University of Trento, Rovereto (Italy); Università degli Studi di Milano-Bicocca (Italy)
Duration: 2021/02 – 2023/09

Background: Many actions stem from the evaluation of the environment until reaching a decision concerning how to act. Prominent psychological models describe decision processes in terms of evidence accumulating towards a response boundary. Once the boundary is reached, the decision is concluded and motor processes can initiate the response. Despite the differences in terms of specific processing dynamics and architectures, many models thus assume a functional segregation of decision and motor processes within serial stages.

Aims: This project questioned the functional segregation between decision and action by investigating the neurocognitive underpinnings of a potentially continuous stream of processes that progressively maps stimulus evaluation to the response channels.

Method: The first study focused on the electromyographic (EMG) signal to measure motor-response duration within lexical and object decision tasks featuring button-press responses. The experiments assessed the propagation of decision-related phenomena, such as lexicality (difference in RTs between words and pseudowords) and word-frequency (high vs. low frequency words) effects, to motor-response execution. The second study exploited both EMG and EEG measures to assess the influence of decisional effects across the multiple stages of the motor-control hierarchy indexed by electrophysiological indexes of response planning (lateralization of beta-frequency activity), programming (lateralized readiness potential), and execution (response duration), while also monitoring long-range interactions captured by cortico-muscular coherence.

Results: The first study revealed increased durations of motor-responses selectively for items with no representations in memory, such as pseudowords. Instead, difference between words remain bounded to the non-motor component of RTs, (the interval before the onset of EMG activity). The second study revealed that these effects are reflected just at the level of response planning and execution, with no involvement of motor-programming and cortico-muscular coherence.

Conclusions: Taken together, the results contradict the assumption of a serial transition from decision to motor stages. However, rather than pointing to the continuous propagation of a single decision variable, the results point towards multiple decision components that are selecively reflected at different stages of motor control.

Keywords: Decision making, Motor control, Electrophysiology

Publications:

Scaltritti, M., Giacomoni, F., Job, R., & Sulpizio, S. (2023). Redefining the decisional components of motor responses: Evidence from lexical and object decision tasks. *Journal of Experimental Psychology: Human Perception and Performance, 49*(6), 835-851. doi: doi.org/10.1037/xhp0001113.

Scaltritti, M., Greatti, E., & Sulpizio, S. (2023). Electrophysiological evidence of discontinuities in the propagation of lexical decision processes across the motor hierarchy. *Neuropsychologia 188*, 108630.

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86/20 – "Age-related changes in motor-cognitive dual-tasking: An electrophysiological investigation of interference at the level of sub-task elements"
*Researcher*s: Subhobrata Mitra, Christina Howard
Institution: Psychology Department, Nottingham Trent University (UK)
Estimated duration: 2021/10 – 2024/04

Background: Continuous sensorimotor coordinations (CSCs) such as driving, walking, using control interfaces or maintaining the body's balance are often performed alongside concurrent cognitive tasks involving attention and executive function. A range of these task combinations show interference, particularly in older adults, but the timing, direction and reciprocity of interference is not yet understood at the level of the tasks' information-processing operations.

Aims: This project compares the chronometry of dual task interference between a visual oddball task and a continuous visuomanual tracking task performed by young and older adults.

Method: The oddball task's constituent operations were identified using the electrophysiological correlates (ERP's P1, P2 and P3b, and time-frequency characteristics in the alpha-beta band range), and deviations in the tracking task reflected perturbations to state monitoring and adjustment characteristics of CSC tasks.

Results: Despite instructions to give equal priority to both tasks, older participants ($N = 28$) maintained a high level of resourcing of the oddball task when dual tasking whereas young participants ($N = 24$) reduced resourcing to accommodate the demands of the tracking task. Older participants had a longer period of tracking inaccuracy during the executive function component of the oddball task, and unlike in young participants, this decrement was also observed when the stimulus was not a target and the executive function of updating the target tally was not required.

Conclusions: These detailed chronometric results clarify that age-related amplification of CSC-cognitive interference is largely due to greater inflexibility in task prioritization. Prioritization of the cognitive task over the CSC in this type of dual tasking may have safety implications in everyday task settings.

Keywords: Dual tasking, Sensorimotor coordination, Event-related potential, Attention, Executive function, Electrophysiology

Publications:
Mitra, S., Boatman, C, & Baker, J. (2022). Age-related changes in the interference between cognitive task components and concurrent sensorimotor coordination. *Brain Research*, *1790*, 147985. https://doi.org/10.1016/j.brainres.2022.147985

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107/20 – "Attitudes and beliefs as predictors of psi effects in a pseudo-gambling task" – only abstract available

Researcher: Lance Storm
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Duration: 2022/01 – 2023/11

Background: It is understood that believers in psi ('sheep') will use psi to hit a target, but non-believers ('goats') will inadvertently use psi to avoid the target. Since the sheep-goat effect is sufficiently demonstrated when sheep score significantly higher than goats, little thought is given to the fact that goats are never specifically asked to psi-miss. The ideal task for goats is to encourage psi-missing (not encourage psi-hitting).

Aims: This study looks at the sheep-goat effect in the context of compliance (from sheep) and noncompliance (from goats). Predictors of psi-hitting due mainly to compliance in sheep, and psi-missing due mainly to noncompliance in goats, are sought in an on-screen forced-choice card-identifying experiment in a gambling scenario. Hypothesized predictors are paranormal belief, gambling attitudes, and beliefs about luck.

Method: The psi task is five trials per participant at guessing the Ace-of-Spades playing card, while avoiding Ace of Clubs (each trial has 5 cards: 1 x Ace-of-Spades; 1 x Ace-of-Clubs; 3 x Kings). Measures on paranormal belief (*Australian Sheep-Goat Scale* [Thalbourne, 1995]), belief in luck (*Belief in Good Luck Scale* [Darke & Freedman, 1997], and *Questionnaire of Beliefs about Luck* [Luke, Roe, & Davison, 2008]), and attitudes towards gambling (*Gambling Attitude Scales* [Kassinove, 1998], and *Attitudes Towards Gambling Scale* [Canale et al., 2016]) were administered to determine correlates of psi performance.

Results: For the whole sample ($N = 120$), effect sizes were at chance for spade-hitting and club-hitting, as was the case for sheep and goats separately. Sheep and goats did not score differently from each other on Spades or Clubs, and none of the scales correlated significantly with the two psi measures. The spade-hitting/club-hitting correlation was negative and significant, thus replicating the effect reported by Storm and Thalbourne (2005). Also, belief in psi and luck, and attitudes towards gambling (whether positive or negative), do not appear to influence gambling success.

Conclusions: The significant spade-hitting/club-hitting correlation suggests that if participants successfully targeted Ace-of-Spades, they tended to avoid Ace-of-Clubs. However, targeting King cards is also an option - in fact, there was mild displacement to King cards at 61.7% (MCE = 60%). Thus, participants could still avoid *noncompliance* if they were sheep, or avoid *compliance* if they were goats, by displacement to King cards.

Keywords: Compliance, Gambling, Noncompliance, Psychic ability, Sheep-goat effect

Publications:

Storm, L. (in press). Attitudes and beliefs as predictors of psi effects in a pseudo-gambling task. *Journal of Parapsychology.*

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108/20 – "A telephone telepathy study: Does genetic relatedness influence psychic abilities?"
Researcher: Helané Wahbeh
Institution: Institute of Noetic Sciences, Novato (USA)
Duration: 2021/03 – 2023/09

Background: Some people claim to occasionally know who is calling them without using traditional means, known as telephone telepathy. Controlled experiments testing these claims report mixed results.
Aims: The objectives of this study were to evaluate: 1) the accuracy of participants in guessing who was calling them and any difference between telepathic/pre-selected versus precognitive/post-selected trials; 2) the relationship between genetic relatedness, emotional closeness, communication frequency, physical distance, and accuracy.

Method: We conducted a cross-sectional study of groups of three participants (triads) who tried to guess who was calling them in 12 trials, six of which the web server randomly chose the caller before the callee's guess (telepathic/pre-selected) and six of which the caller was selected after the callee's guess (precognitive/post-selected). We also performed exploratory multilevel mixed-effects logistic regressions on the relationship of genetic relationships, emotional closeness, communication frequency, and physical distance data with accuracy.

Results: A total of 177 participants completed at least one trial (105 "completers" completed all 12 trials). Accuracy was significantly above chance for the 210 completers telepathic/pre-selected trials (50.0% where the chance expectation was 33.3%, p<.001) but not the 630 completers precognitive/post-selected trials (31.9% where the chance expectation was 33.3%, $p = .61$). We discuss how these results favor the psi hypothesis, although conventional explanations cannot be completely excluded. Genetic relatedness significantly predicted accuracy in the regression model (Wald $\chi2 = 53.0$, $P < .001$) for all trials. Compared to 0% genetic relatedness, the odds of accurately identifying the caller was 2.88 times (188%) higher for 25% genetic relatedness (Grandparent/Grandchild or Aunt/Uncle or Niece/Nephew or Half Sibling; $\beta = 1.06$, $z = 2.10$, $P = .04$), but the other genetic relatedness levels were not significant. In addition, communication frequency was significant ($\beta = 0.006$, $z = 2.19$, $P = .03$) but physical distance ($\beta = 0.0002$, $z = 1.56$, $P = .12$) and emotional closeness ($\beta = 0.005$, $z = 1.87$, $P = .06$) were not for all trials. To facilitate study recruitment and completion, unavoidable changes due to persistent recruit difficulties to the protocol were made during the study, including changing inclusion/exclusion criteria, increasing total call attempts to participants, adjusting trial type randomization schema to ensure trial type balance, and participant compensation.

Conclusions: We observed significantly above-chance results for trials in which the web server pre-selected the callee and the caller was asked to direct their attention toward them, aligning with results from previously reported studies. Communication frequency between pairs of people was also associated with greater accuracy. The influence of emotional closeness and genetic relatedness did not appear to influence accuracy. Our findings add to the mixed results on these potential relationships. Continued research is needed to evaluate claims that people sometimes know who is calling without any conventional cues. Thus, future research will be needed to continue to improve the methodology and examine the mechanism by which people claim to know who is calling, as well as factors that may moderate the effects.

Keywords: Anomalous cognition, Telepathy, Precognition, Telephone

Publications:
Wahbeh, H., Cannard, C., Radin, D., & Delorme, A. (2023). Who's calling? Evaluating the accuracy of guessing who is on the phone. *Explore*, S1550-8307(23)00180-5. Advance online publication. https://doi.org/10.1016/j.explore.2023.08.008.

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123/20 – "A latent profile analysis and structural equation modelling of paranormal belief, psychopathological symptoms, and well-being"

Researchers: Neil Dagnall, Andrew Denovan
Institution: Health, Psychology and Communities, Manchester Metropolitan University (UK)
Duration: 2021/02 – 2023/06

Background: Research investigating links between paranormal belief, psychopathology, and reduced well-being has produced inconsistent findings. The most reliable outcome being an association between paranormal belief and psychosis-proneness. Accordingly, this project used a range of analytical techniques to further explore links between paranormal belief and reduced well-being.

Aims: To identify profiles combining paranormal belief and psychopathology (Phase 1). Additionally, to develop and test models examining how emergent profiles relate to well-being over a period of six months (Phase 2).

Method: The two project phases included cross-sectional and longitudinal methods. These surveyed participants via online self-report measures. Alongside the Revised Paranormal Belief Scale, participants completed a range of cognitive-perceptual, psychopathology-related, and well-being measures (e.g., Perceived Stress, Life Satisfaction, Manic-Depressiveness, Schizotypy, Transliminality).

Results: Statistical procedures included latent profile analysis (LPA), MANOVA, and longitudinal mediation. Phase 1 LPA identified subgroups of high, moderate, and low combined Paranormal Belief and psychopathology (Schizotypy, Depression, Manic-Depressive Experience) scores. MANOVA revealed that subgroups with higher psychopathology scores (not necessarily higher Paranormal Belief) reported significantly lower wellbeing (Perceived Stress, Somatic Complaints, and Life Satisfaction; all $p<.001$). Phase 2 LPA identified consistent subgroups to Phase 1. Path analysis over six months demonstrated that the profile highest in psychopathology (not Paranormal Belief) predicted significantly lower well-being (higher Perceived Stress, $\beta = .34$, and Somatic Complaints, $\beta = .26$). Transliminality and Fearful Attitude positively mediated this relationship, and Sceptical Attitude produced negative mediation. The path model revealed good fit, χ^2 (1) = 8.10, $p = .004$, CFI = .99, SRMR = .01, RMSEA = .06 (95%CI of .03-.09).

Conclusions: A consistent observation across a range of methodological approaches was that paranormal belief, in the absence of cognitive-perceptual and psychopathology-related factors, had no significant relationship with well-being. Rather, a sophisticated process underpinned this, inferring that paranormal belief does not necessarily influence lower psychological adjustment and reduced well-being. Rather, attendant constructs (e.g., transliminality, psychopathology) facilitate this.

Keywords: Paranormal belief, Psychopathology, Well-being, Psychological adjustment, Longitudinal

Publications:

Dagnall, N., Denovan, A., & Drinkwater, K. G. (2023). Longitudinal assessment of the temporal stability and predictive validity of the Revised Paranormal Belief Scale. *Frontiers in Psychology*, *13*, 1094701. https://doi.org/10.3389/fpsyg.2022.1094701

Dagnall, N., Denovan, A., & Drinkwater, K. G. (2022). Paranormal belief, cognitive-perceptual factors, and well-being: A network analysis. *Frontiers in Psychology*, *13*, 967823. https://doi.org/10.3389/fpsyg.2022.967823

Dagnall, N., Denovan, A., Drinkwater, K. G., & Escolà-Gascón, Á. (2022). Paranormal belief and well-being: The moderating roles of transliminality and psychopathology-related facets. *Frontiers in Psychology*, *13*, 915860. https://doi.org/10.3389/fpsyg.2022.915860

Drinkwater, K. G., Denovan, A., & Dagnall, N. (*under review*). A latent profile analysis and longitudinal assessment of the relationship between paranormal belief, psychopathological symptoms, and well-being. *PLOS One*.

Drinkwater, K. G., Denovan, A., & Dagnall, N. (*in press*). Paranormal belief and perceived stress: A re-evaluation using the two factor RPBS model and statistical modelling. *PLOS One*. https://doi.org/10.1371/journal.pone.0297403

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129/20 – "Investigating the role of expertise in the predictive coding framework combining time resolved neural and behavioural evidence"

Researchers: Marie Smith, Inês Mares, Louise Ewing, Fraser Smith
Institution: Department of Psychological Sciences, Birkbeck, University of London (UK)
Estimated duration: 2021/08 – 2024/02

Background: Perceptual decisions are derived from the combination of priors and sensorial input. While priors are broadly understood to reflect experience developed over one's lifetime, the role of perceptual expertise at the individual level has seldom been directly explored.

Aims: Here we sought to better understand the role of expertise in forming expectations, and its downstream effect on perception itself. Across a series of experiments we assess this question in the contexts of categorization, individuation (i.e. identity processing), and low level processing (perceiving a face across different viewpoints).

Method: Here, we will focus on the first study, where we explored the role of expectation on stimuli categorization by manipulating probabilistic information associated with a high and low expertise category (faces and cars respectively). 67 participants learned the association between a color cue and each target category (face/car) in a behavioural categorization task. We then recorded neural activity (EEG) in a second task that used a similar paradigm (featuring the previously learned contingencies) and participants performed an orthogonal letter detection task to keep attentive. Finally, we measured individual level expertise for faces and cars (faces, CFMT+; cars, CCMT).

Results: Behaviourally, perception of the higher expertise category (faces) was modulated by expectation (p = .009), indicating both facilitatory (i.e. correct expectation facilitated object categorization) and interference effects (i.e. incorrect expectation hindered object categorization). These were associated with individual levels of face expertise (p = .018 and p = .015 respectively). Multivariate pattern analysis of the EEG signal classifying high and low face expectation revealed clear effects of expectation from 100 ms post stimulus both when participants saw faces or cars (one-tailed paired samples t-test comparing decoding of classifiers and chance level across all participants, FDR corrected, $p < 0.05$). Latency of peak decoding when viewing faces was directly associated with individual level facilitation effects in the behavioural task (p = .033).

Conclusions: These results highlight the role of expectations on informing perception. At the neural level, our data provides time sensitive evidence of expectation effects on early perception at a latency of around 100 ms. Importantly, the present findings reveal the critical role of higher-level expertise on forming priors.

Keywords: Prediction, Expertise, Face processing, EEG, MVP

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131/20 – "From inner to dyadic connection: The effect of mindfulness intervention on mother-infant bio-behavioural synchrony"

Researchers: Maria Spinelli, Chiara Suttora, Filippo Zappasodi
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Estimated duration: 2021/09 – 2024/04

Background: During infancy, mother-infant bio-behavioural synchrony, the temporal coordination of mother's and infant's behavioural and neuro-physiological cues during interactions, is considered the core aspect of positive parent-child relationship, with positive effects on infant later development. The literature on mindfulness claims that we connect better with others if we are aware of and connected with our own inner experience. Thus, mindfulness, while promoting the mother's connection with her own inner world, might promote maternal attunement with the infant's states.

Aims: To explore the effects of mindfulness on mother-infant synchrony.

Method: 67 mother-infant dyads were video-recorded during face-to-face interactions at 3 and 6 months of life. Mothers completed questionnaires on their dispositional (FFMQ) and interpersonal (IMP) mindfulness. Mother's and infant's affective behaviours were coded with Tronick's ICEP coding system. Physiological activation was computed with each partner's Respiratory Sinus Arithmis (RSA, with ECG sensors) each 20s. Mother's and infant's neural activation was recorded with EEG cups. 34 dyads participated at a mindfulness intervention of 5 weeks, 18 were part of the control group. Both groups were assessed again 5 weeks later.

Results: RSA of more mindful mothers was more influenced by infant's RSA ($\beta = 0.57$, $p < .00$) (high physiological synchrony) than RSA of low mindful mothers. Mindfulness was associated with more matching of mother-infant's positive affective states ($r = .24$). A greater lateralization of brain activity for the alpha and gamma bands power ($F = 2.50$, $p = .03$ and $F = 4.12$, $p = .05$) was evidenced only in high mindful mothers. This high hemispheric specialization of high mindful mothers indicates an optimized emotional and cognitive functioning representing motivation to social engagement during the interaction. Preliminary findings on the effectiveness of the intervention suggested an increase in interpersonal mindfulness ($t = 1.99$, $p = .05$) and in the proportion of shared interactive moments ($t = 2.15$, $p = .03$) only in the intervention group.

Conclusions: These results highlight the role of expectations on informing perception. At the neural level, our data provides time sensitive evidence of expectation effects on early perception at a latency of around 100 ms. Importantly, the present findings reveal the critical role of higher-level expertise on forming priors.

Keywords: Mother-infant interaction, Mindfulness, Behavioral synchrony, Physiological synchrony, Neural activity

Publications:

Passaquindici, I., Nardozza, O., Sperati, A., Lionetti, F., D'Urso, G., Fasolo, M., Spinelli, M. (*under review*). Maternal dispositional mindfulness and mother-child relationship: The mediating role of emotional control during parenting. *Child: Care, Health and Development.*

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169/20 – "Investigation of the phenomenology and impact of spontaneous and direct After-Death Communications (ADCs)"

Researchers: Callum Cooper, Evelyn Elsaesser
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Estimated duration: 2021/02 – 2024/04

Background: An ADC occurs when a person unexpectedly perceives a deceased person in a manner that is interpreted as indicative of the continued survival of some aspect of that person. Such experiences are common in the general population, particularly following bereavement, but are poorly understood. More detailed mapping of the phenomenology, circumstances and impacts of ADCs will enable the explanations that have been proposed to be evaluated more thoroughly.

Aims: Our objectives were to interrogate cases of ADCs reported to us by the general public, analyzing already-collected data from English, French, and Spanish language groups, focusing especially on material that putatively supports the survival interpretation, such as cases involving multiple witnesses, or ADCs that provided previously unknown information to the percipient. We also aimed to launch additional versions of the survey in German, Dutch, and Chinese.

Method: Mixed methods analysis of the original multinational survey to describe the phenomenology of ADCs, with a particular focus on cases that might provide more direct evidence that would bear on the question of survival. Development and implementation of new surveys using the JISC platform.

Results: The original database comprises 994 ADC cases. Papers have been published that report on prevalence of different ADC types, and observing that they commonly occur among people without a mental health diagnosis or other comorbidity. We have also reported on the impacts of ADCs upon the percipient's religiosity, spirituality, and attitude towards biological death. Other published analyses have focused on the effects of frightening ADCs, effects upon spouses and partners, and the status of ADCs as scientific evidence for survival of bodily death. The German survey has closed, generating 235 additional responses that are in the process of being translated and analysed. Our Dutch survey generated 17 viable responses, which are being analysed separately as part of a small qualitative study. The Chinese survey is currently live.

Conclusions: The analyses conducted reflect a growing awareness within the clinical parapsychology community that anomalous experiences are not usually distressing per se, but rather the negative reactions of others can have adverse effects upon the experiencer's health and wellbeing. An important purpose of the project is to normalize ADCs so as to enable percipients to feel able to disclose them to others without fear of ridicule or pathologisation. In this way, they may be enabled to reflect on and process their experiences in ways that are compatible with their personal belief system so as to promote integration and growth. To this end, project members have been actively engaged in disseminating balanced, evidence-based information about ADCs among mental health professionals who may encounter ADC experiencers.

Keywords: After death communication, Deceased, Contact, Bereavement

Publications:

Elsaesser, E., Roe, C. A., Cooper, C. E., & Lorimer, D. (2021). The phenomenology and impact of hallucinations concerning the deceased. *BJPsych Open*, *7*, Article e148. https://doi.org/10.1192/bjo.2021.960

Evrard, R., Dollander, M., Elsaesser, E., Cooper, C., Lorimer, D., & Roe, C. (2021). Exceptional necrophanic experiences and paradoxical mourning: Studies of the phenomenology and the repercussions of frightening experiences of contact with the deceased. *L'Évolution Psychiatrique*, *86*(4), e1-e24. https://doi.org/10.1016/j.evopsy.2021.09.001

Penberthy, J. K., Pehlivanova, M., Kalelioglu, T., Roe, C. A., Cooper, C. E., Lorimer, D., & Elsaesser, E. (2023). Factors moderating the impact of after death communications on beliefs and spirituality. *Omega - Journal of Death and Dying*, *87*(3), 884–901. https://doi.org/10.1177/00302228211029160

Penberthy, J. K., St Germain-Sehr, N. R., Grams, G., Burns, M., Lorimer, D., Cooper, C. E., Roe, C. A., Morrison, S., & Elsaesser, E. (2023). Description and impact of encounters with deceased partners or spouses. *Omega*, 302228231207900. Advance online publication. https://doi.org/10.1177/00302228231207900

Roe, C., Cooper, C., Lorimer, D., & Elsaesser, E. (2021, November 24). A critical evaluation of the best evidence for the survival of human consciousness after permanent bodily death. *Bigelow Institute*. https://www.bigelowinstitute.org/Winning_Essays/11_Chris_Roeet_et_al.pdf

Woollacott, M., Roe, C. A., Cooper, C. E., Lorimer, D., & Elsaesser, E. (2022). Perceptual phenomena associated with spontaneous experiences of after-death communication: Analysis of visual, tactile, auditory and olfactory sensations. *Explore*, *18*(4), 423-431. https://doi.org/10.1016/j.explore.2021.02.006

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174/20 – "In your skin: The psychophysiology of touch observation" – only abstract available
Researcher: Bettina Forster
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Estimated duration: 2021/09 – 2024/03

Background: Previous studies of touch observation suggest that we automatically simulate observed touch experiences in our own body representation including primary and secondary somatosensory cortex (SCx). This suggests a reflexive mirroring of other's sensory experiences through activation of early sensory areas.

Aims: Here we investigated whether (a) task instructions and the engagement with the overserved touch (i.e. ignoring vs feeling) modulate the activation of early sensory areas, and whether (b) the quality of the texture of the observed touch (i.e. soft vs hard) modulates such early sensory SCx activations.

Method: We measured ERPs of SCx's hierarchical processing stages which map onto successive somatosensory ERP components to investigate the timing of touch observation effects. In the first experiment, participants (n=43) merely observed touch or no-touch to a hand; in the second, participants saw different touch textures (foam and rubber) either touching a hand (other-directed touch) or they engage with observed texture (self-directed). We probed SCx activity and isolated SCx touch observation activations from visual carry over effects.

Results: We found evidence of absence of early sensory SCx modulations (e.g. P50, N80) in both experiments. We only found touch observation effects on a later processing stage (i.e. Late Positive Complex) and on behavioural responses to an imperative stimulus presented after each touch observation sequence consistent with post-perceptual effects. Importantly, early and mid-latency components were only modulated in the self-directed touch condition, when participants were instructed to feel the (visual) touch, consistent with early sensory SCx activations. Furthermore, these early sensory SCx activations were not modulated by observed touch texture.

Conclusions: Therefore, SCx is purposely recruited when engaging with observed touch. Such activations situate the perceptual experience in the relevant sensory cortex rather than fully simulate the sensory experience.

Keywords: Touch observation, Somatosensory, ERPs

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191/20 – "Understanding the brain mechanisms of death-denial for fostering mindfulness-based existential resilience" – only abstract available

Researchers: Aviva Berkovich-Ohana, Yair Dor-Ziderman
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Duration: 2022/01 – 2024/01

Background: Virtually all human wisdom traditions, East and West, from the Buddhist contemplative tradition to the Greek Stoics to existential philosophy recognize that the path to human post-conventional development passes through the experiential realization, and acceptance, of one's ultimate and inevitable cessation. We term this mental quality of facing up to one's death as existential resilience. We recently showed using a magnetoencephalogram (MEG) visual mismatch-response paradigm that prediction-based mechanisms mediate death-denial by shielding the self from existential threat. However, whether this protective mechanism which operates on early self-specific perceptual processes is amenable to change by mental training is unknown.

Aims: Building on this neurophysiological death-denial paradigm we aimed to: (1) gain understanding of the basic neural implementation, resilience factors, and downstream implications of death-denial, and (2) assess its regulation by mindfulness, with altered self-processing as the mechanism-of-action.

Method: Two cohorts consisting of meditation practitioners (n=38) and meditation-naïve participants (n=50) completed questionnaires and underwent the MEG death-denial task. In addition, the meditators voluntarily entered self-dissolution states in the lab and underwent phenomenological interviews for experientially mapping these states.

Results: Our results indicated that meditators' brain evidenced an acceptance rather than denial of death, in a manner indicating increased well-being. Furthermore, death acceptance was predicted by positive valence, but not by depth, of the lab-induced dissolution experiences. Meditation-naïve data further indicated that death denial defenses collapsed due to the prolonged real-life existential terror of Covid-19, and in turn, impacted participants' concern towards the environment.

Conclusions: Based on the results we can conclude that the neural mechanisms underlying the human death denial system are plastic and change as an adaptive response to severe external circumstances involving acute and prolonged elevated levels of mortality salience, but also as a result mindfulness mind training. Additionally, we presented initial evidence that wholesome self-dissolution experiences may act a mechanisms-of-change. These results open up the field for longitudinal studies of the efficacy of targeted mindfulness-based existential interventions aiming at fostering existential resilience.

Keywords: Death-denial, Mindfulness meditation, Existential resilience, Self-dissolution, Magnetoencephalography

Publications:

Berkovich-Ohana, A., Brown, K.W., Gallagher, S., Barendregt, H., Bauer, P., Giommi, F., Nyklíček, I., Ostafin, B., Raffone, A., Slagter, H.A., Trautwein, F-M., & Vago, D. From self to selflessness: How meditation transforms the self-pattern. Paper under consideration in *Mindfulness.*

David, J., Bouso, J. C., Kohek, M., Ona, G., Tadmor, N., Arnon, T., Dor-Ziderman, Y., & Berkovich-Ohana, A. (2023). Ayahuasca-induced personal death experiences: prevalence, characteristics, and impact on attitudes toward death, life, and the environment. *Frontiers in Psychiatry, 14*, 1287961. https://doi.org/10.3389/fpsyt.2023.1287961

Dor-Ziderman, Y., David, J., & Berkovich-Ohana, A. Death-denial in times of Covid-19 and its effect on environmental attitudes. Paper under consideration in *Nature Climate Change.*

Dor-Ziderman, Y., Schweitzer, Y., Nave, O., Trautwein, F-M., Fulder, S., Lutz, A., Goldstein, A., & Berkovich-Ohana, A. Mindfulness meditators' brains show an acceptance of death which predicts positively-valenced meditative self-dissolution experiences. Paper under consideration in *Nature Human Behavior*.

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203/20 – "Dynamic eye-movement encoding in human cortex using ultra-high field fMRI (7Tesla)" – only abstract available

Researcher: Alessio Fracasso
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Duration: 2021/10 – 2023/09

Background: Eye movements are a paradigmatic example of a sensory change, induced by the motor system. In human vision the eyes actively sample the environment. If we were to perceive the world exactly as it is displayed if front of our eyes, the visual scene would seem a sequence of frequent and large jumps, making any matching attempts between them impossible. The visual system needs to distinguish 'jumps' that are due to saccades as opposed to changes in the external world. The oculo-motor system provides a warning of an upcoming eye movement (corollary discharge); thus, the visual system can compensate for it and achieve the stability of the visual input across eye movements during active vision.

Aims: To characterize i) how the visual system keeps track of sensory changes over time by means of gain fields - that is, gain modulated responses in visually responsive cortex, coupled with eye position, allowing to infer eye position at any given time from a population level. ii) Characterize how kinematic properties are mapped within human neocortex.

Method: High-field imaging at 7T, measuring BOLD signal in human neocortex. Data was acquired using a 7T Magnetom Terra MRI scanner (Siemens, Erlangen, Germany) and 32-channel head coil (Nova Medical Inc., Wilmington, MA, USA) at the Imaging Centre of Excellence (University of Glasgow, UK). The analysis incorporated state of the art forward modelling techniques. 12 participants took part in the first stage of the investigation (Eye movement topography, 3 MRI session for each participant) and 11 participants took part in the second stage of the investigation (Gain field estimation, 3 MRI session for each participant).

Results: Gain fields can be observed throughout human visual cortex. Saccade kinematics is mapped specifically in human parietal cortex.

Conclusions: Human neocortex keeps track of sensory changes via the gain field mechanism. Distributional features of gain fields and saccade kinematics are topographically arranged in human neocortex.

Keywords: Gain-fields, Saccade kinematics, Human neocortex, High-field imaging

Publications:

Fabius, J. H., Moravkova, K., & Fracasso, A. (2022). Topographic organization of eye-position dependent gain fields in human visual cortex. *Nature Communications*, *13*(1), 7925. https://doi.org/10.1038/s41467-022-35488-8

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212/20 – "Comparing cognitive styles among parapsychology researchers, psi-believers, and skeptics"

Researchers: Marieta Pehlivanova, Bruce Greyson
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Estimated duration: 2021/03 – 2024/04

Background: Much research has explored factors that impact belief in psi, which is widespread but controversial. Examples of psi include extra-sensory perception, psychokinesis, and survival after death. Studies have shown that there are cognitive differences between people who believe in psi and those who don't, but much of this work has been done with lay believers. Among academics, psi belief varies as well, and some researchers have spent their careers studying psi phenomena, while others have criticized such efforts. Relevant to these endeavors are cognitive styles such as actively open-minded thinking (AOT), which measures one's willingess to consider a range of evidence when forming an opinion, including evidence that goes against one's beliefs. AOT is a disposition towards "good" thinking about evidence.

Aims: To assess differences in cognitive styles among psi researchers, lay psi believers, and skeptics of psi phenomena and research.

Method: We used online surveys to collect data on cognitive styles, belief in psi, and demographic characteristics in four groups. Academic psi researchers (N = 44) were recruited from research mailing lists in the field or by email invitation to known researchers. Academic or professional skeptics (N = 35) were recruited by email invitation to fellows of the Committee for Skeptical Inquiry and some academics who have been critical of psi. Lay psi believers (N = 32) were recruited from Facebook groups on paranormal interests and organizations focused on exploring psi. Lay skeptics (N = 33) were recruited via skeptical interest groups. We used ANOVA and ANCOVA to explore group differences in cognitive styles, including AOT, as dependent variables.

Results: Psi researchers and lay psi believers had significantly higher belief in psi than both skeptical groups. ANOVA revealed group differences in AOT scores (p = .003). Post-hoc tests showed no significant difference in AOT between psi researchers (4.5±0.3) and academic skeptics (4.5±0.3; p = .91) or lay skeptics (4.5±0.4; p = .80). Lay psi believers had significantly lower AOT scores (4.2±0.4) than the other three groups (ps: .005-.04). AOT was negatively associated with psi belief in the two skeptics groups combined (r = -.29, p = .01), but not in the believers groups (r = -.03, p = .78).

Conclusions: Psi researchers differ from lay psi believers, but not from skeptics, on actively open-minded thinking, suggesting that, despite their high belief in psi, they may constitute a distinct group in terms of psi belief formation. Psi researchers' commitment to good thinking about evidence is on par with skeptics.

Keywords: Cognitive styles, Belief in psi, Psi researchers, Skeptics, Parapsychology

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216/20 – "Analysis of an entropic anomaly in 23 years of truly random data" – only abstract available

Researcher: Dean Radin
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Duration: 2022/01 – 2023/02

Background: Beginning in 1998 and continuing to the present day, a network of electronic random number generators located around the world has continuously recorded samples of truly random bits. The data from this "Global Consciousness Project" (GCP) are used to explore a mind-matter interaction hypothesis that predicts the emergence of anomalous structure in randomness correlated with events that attract widespread human attention. A formal experiment testing this hypothesis from 1998 to 2015, based on selection of 500 events of worldwide interest, found a highly significant (7.3 sigma) deviation from chance expectation.

Aims: The duration of the aforesaid 500 events comprised less than 5% of all data available through 2022, so the present analysis examined the full database to see if emergence of nonrandom structure was limited to those 500 events, or if it appeared continually as a persistent, ongoing relationship between collective mind and matter.

Method: The raw daily data collected by the GCP from 1998 through 2022, consisting of some 110 GBytes of samples based in turn on approximately 4 trillion generated random bits, were downloaded from the GCP's publicly accessible data repository. These data were analyzed using a multiscale entropy technique and separately via a deconvolution procedure developed as part of this research project.

Results: The two analytical approaches independently showed that significant temporal structure (ranging from 3 to 6 sigma beyond the null hypothesis, depending on the method used) did occur, supporting the idea that mind-matter interactions are continuously generating anomalous order in randomness, and not just during especially noteworthy events.

Conclusions: As a long-term study in "experimental metaphysics," the GCP has confirmed in several ways the presence of an ongoing correlation between mind and matter. In the present case the mind involved innumerable groups of people, small and large, engaged in coherent mental focus, and the matter was the behavior of random events based on quantum indeterminate sources. While the existence of a correlation is clear, the underlying mechanisms giving rise to this relationship remain uncertain.

Keywords: Random number generator, Mind-matter interaction, Global consciousness project, Negentropy

Publications:

Radin, D. (2023). Anomalous entropic effects in physical systems associated with collective consciousness. *Physics Essays*, *36* (1), 76-86 https://doi.org/10.4006/0836-1398-36.1.77

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249/20 – "Physiological correlates to variations in ultra-weak photon emissions during periods of focused intent"

Researcher: John Kruth
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Estimated duration: 2021/05 – 2024/04

Background: All organic matter, including people, produce Ultraweak Photon Emissions (UPE). There are indications that UPE increase during moments of intentional focus, and physiological measurements may provide insight into the mechanisms behind UPE increases.

Aims: The first hypothesis (H1) is a confirmation of previous studies indicating that UPE can be intentionally produced during moments of focus. We also explored correlations between physiological factors and increased expression of UPE (H2) and whether these factors indicated a state of arousal (H3).

Method: Fifty 20-minute sessions were completed by five participants. UPE were measured using a photomultiplier tube in a double dark room. Each session included a control condition for each participant with a resting period (10 minutes; no focus) and an active period of intense focus (10 minutes). Resting state UPE counts were compared to counts during the period of focus to address H1. See BIAL 151/06 for details. Electrocardiogram (ECG), respiration (RES), electrodermal activity (EDA), skin temperature (TEMP), and blood flow (FLOW) were continuously measured for each session, and heart rate variance (HRV) and heart rate per minute (HR) were calculated. Analyses across all participants explored correlations between increasing UPE and each physiological factor to address H2.

Results: H1 was strongly supported across all participants (p < 2.2e-16). In addition, there were 103 events where UPE counts during the focus period exceeded the mean UPE count by more than six-sigma. Independent of UPE counts, periods of focus resulted in increased HR, more consistent HRV, decreasing FLOW (each p < 2.2e-16), and increased TEMP (p = 1.46e-14). Only increased HR and more consistent HRV were significantly correlated with increased UPE values (r = 0.230) supporting H2 across all participants. Mixed physiological correlations make it difficult to determine whether arousal was the dominant state during increased UPE (H3), but individual analyses per participant may provide great insight.

Conclusions: Experienced participants are able to intentionally express UPE during periods of focus, and a faster and more consistent HR appears to be correlated with greater expressions of UPE. Additional analysis is necessary to determine whether arousal is associated with the increase in UPE.

Keywords: Ultra-weak photon emissions, Physiology, Biophotons, UPE, HRV, Arousal

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258/20 – "In God's shoes: Embodying the avatar of the supreme moral authority modulates psychophysiological indices of one's own morality"

Researchers: Salvatore Maria Aglioti, Michael Schepisi, Althea Frisanco, Gaetano Tieri
Institution: Department of Psychology, "Sapienza" University of Rome (Italy)
Duration: 2021/06 – 2023/09

Background: Studies highlight the potential of virtual embodiment illusions in shaping individuals' perceptions, attitudes, and behaviors, a phenomenon that people refer to as the Proteus effect.

Aims: Building upon this research, we investigated the impact of embodying an anthropomorphic representation of the Christian God on sense of power (research stream 1, RS 1, composed of Study 1 and Study 2) and moral standards (RS 2, composed of Study 3 and Study 4), assuming that being virtually God led people to perceive themselves as more powerful and influenced moral conflict experiences, leading participants to feel entitled to interfere in human fate.

Method: In RS 1, we first examined participants' reactions to a life-threatening event and then asked them to evaluate their physical abilities while embodying the God-avatar or two human control avatars. Each participant experienced all the three avatars in a within-subject design. In Study 1, we presented them with an unexpected ground collapse, measuring physiological response (Skin Conductance Response, SCR, and Beat Per Minute, BPM) and emotional self-report states. In Study 2, we asked participants to evaluate the maximum distance they thought they could jump and we measured the reported estimated distance. In RS 2, we observed participants resolving moral conflicts using both a text-based moral dilemma version and an immersive version. In Study 3, we presented participants with 30 text-based moral dilemmas with two possible resolutions (i.e., deontological or utilitarian) while they were embodying both the God-avatar or a control human one in a within-subject design. We measured participants' resolution, related-feelings, reaction time and physiological reaction (SCR and BPM). In Study 4, we implemented the Trolley and the Footbridge dilemma in the virtual environment and required the participants to act in the scene to solve the dilemma while embodying the God-avatar or a control human in a between-subject design. The same measures of Study 3 were administered.

Results: Study 1 showed that when participants were embodying the God-avatar exhibited distinct physiological responses, i.e., a reduced skin conductance response ($p = 0.03$) and a deceleration of heart rate ($p = 0.01$); Study 2 showed that in the God-avatar they reported empowerment of their physical abilities ($p < 0.01$). Overall, the results of RS 1 suggested that participants may have experienced an increased sense of invulnerability and power while embodying the omnipotent agent. In Study 3, the God-avatar did not seem to have an impact on the experience and resolution of the textual dilemmas. In Study 4, we found the God-avatar to affect BPM ($p = .02$) when participants chose the utilitarian resolution in the Trolley dilemma, and led to perceive the utilitarian resolution in the Footbridge dilemma as more moral ($p = .02$). In the Footbridge dilemma, we found that the more the participants perceived God as benevolent, the more they experienced guilt ($p = .03$), shame ($p = .05$) and the less they evaluated the utilitarian resolution as moral ($p < .05$). Overall, the results of RS 2 suggested that participants may feel more involved in the scene when they embodied the supreme moral-judge, but that the representation they have of the character is a crucial factor to consider if we want to investigate the Proteus effect on the moral dimension.

Conclusions: Overall, our research significantly contributes to advancing knowledge in the field of the Proteus effect. It prompts us to consider the domains, conditions, and tasks for which virtual embodiment works and is most effective when it involves characters to whom complex personality traits and social roles are attributed.

Keywords: Virtual embodiment illusion, Proteus effect, Moral decision making, Threat reaction

Publications:

Frisanco, A., Schepisi, M., Tieri, G., & Aglioti, S. M. (2022). Embodying the avatar of an omnipotent agent modulates the perception of one's own abilities and enhances feelings of invulnerability. *Scientific Reports*, *12*(1), 21585. https://doi.org/10.1038/s41598-022-26016-1

Frisanco, A., Schepisi, M., Tieri, G., & Aglioti, S. M. (*under review*). Does embodying a divine avatar influence moral decisions? An immersive virtual reality study.

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276/20 – "Beyond your own body: Extending the bodily self to the neuroaesthetics of interactions"
Researchers: Andrea Orlandi, Matteo Candidi, Martina Fanghella, Quentin Moreau, Ugo Giulio Pesci
Institution: Department of Psychology, "Sapienza" University of Rome (Italy)
Estimated duration: 2021/02 – 2024/04

Background: Dance represents an ideal framework for neuroscientific investigations on body and movement representation. Several studies on single-body observation revealed a strong link between aesthetic appreciation, observer expertise, and objective movement features. Body-sensitive visual occipitotemporal brain areas appear to be modulated by visuospatial features of body dyads, such as their relative positioning. However, further exploration is needed to understand the role of emotional and semantic content in modulating body dyad visual processing and aesthetic responses to dancing dyads. Similarly, the potential influence of multisensory spatial (peripersonal space) representations on aesthetic evaluation is a novel hypothesis.

Aims: The current project investigated behavioural responses and neural correlates of the aesthetic, emotional, and semantic evaluation of non-symbolic (dance-like) body dyads as a function of their visuospatial complexity in non-dancer observers.

Method: The project used a multi-method approach, including motion capture for stimuli creation, participants' ratings, visuomotor training, and electroencephalography (EEG). Our approach integrated the "two-person neuroscience" perspective with classical observation studies and resulted in three studies. Stimuli were created by involving two contemporary dancers with a dance-inspired training, digitally capturing their movement kinematics, and quantifying visuospatial features between bodies. Individual evaluations of the stimuli were collected in all three studies. In Study 3, two groups of participants were engaged in two-person interactions (participant-confederate), allowing them to assume postures represented in the visual stimuli before observing (and evaluating) the body dyads during EEG recording.

Results: The aesthetic appreciation of body dyads depends on a combination of individual and objective features, including the shared interpersonal space between bodies (Study 1). Body dyads that are perceived as more interactive and meaningful appear to benefit from configurational processing (Study 2). Preliminary findings suggest that a short-term, intense visuomotor training, which facilitates an observer's spatial and somatosensory representation of the observed configurations, modulates body dyad processing (Study 3).

Conclusions: The dialogue and knowledge transfer between scientific and performative research appears to be a privileged gateway to social cognition studies.

Keywords: Neuroaesthetics, Body dyads perception, EEG, Visuomotor training, Dance

Publications:
Fanghella, M., Era, V., & Candidi, M. (2021). Interpersonal motor interactions shape multisensory representations of the peripersonal space. *Brain Sciences, 11*(2), 255. https://doi.org/10.3390/brainsci11020255
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287/20 – "Title: Emotional distraction: Contextual modulation of attentional capture" – only abstract available

Researchers: Maurizio Codispoti, Cristina Filannino
Institution: Department of Psychology, University of Bologna (Italy)
Duration: 2021/04 – 2023/02

Background: Previous research has demonstrated that repeated exposure to events (visual distractors) that are clearly irrelevant leads to more efficient filtering of those events. Whether top-down or contextual factors can modulate the filtering of emotional distractors is a matter of debate. The current project extends this line of research by investigating how novelty affects electrocortical responses to emotional distractors.

Aims: The primary aim of the present project was to investigate whether and how contextual factors affects emotional processing by using behavioural and neural measures that could inform about the stages in which the filtering mechanisms of task-irrelevant visual stimuli operate. Several studies have shown that repeated exposure with clearly irrelevant events leads to more efficient filtering of those events. One type of repeated exposure is simply when the same stimulus is repeated several times. It is well known that, after several repetitions, attentional capture prompted by emotional distractors is strongly attenuated (experiment 1). On the other hand, another way of becoming experienced with distractors is to vary the frequency of their occurrence (experiment 2).

Method: In two experiments, we investigated the effects of stimulus repetition and distractor frequency on the processing of task-irrelevant novel stimuli, as reflected in both behavioral interference and neural activity (alpha ERD and Late Positive Potential; LPP), while participants were engaged in an orientation discrimination task.

Results: The findings demonstrated that the filtering mechanisms regulating emotional interference can be attenuated through a non-strategic learning mechanism mediated by (1) mere stimulus repetition and (2) the frequency of distractors occurrence. In both cases, however, neural measures of emotional processing (alpha-ERD and LPP) remained unaltered, suggesting that our perceptual system serves the adaptive function of identifying potential threats or rewards and, eventually, reacting appropriately.

Conclusions: Our data suggest that emotional information is continuously evaluated, and this process seems mandatory and occurs even when emotional stimuli are task-irrelevant, regardless of the context in which these stimuli are presented. The current project might have important implications for the current society, where people are constantly bombarded by information that could ultimately cause psychological stress, a recently named technostress condition.

Keywords: Distraction, Emotion, Orienting response

Publications:

Ferrari, V., Canturi, F., & Codispoti, M. (2022). Stimulus novelty and emotionality interact in the processing of visual distractors. *Biological Psychology*, *167*, 108238. https://doi.org/10.1016/j.biopsycho.2021.108238

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309/20 – "Assessing static and dynamic effects of mindfulness meditation on peripersonal space"

Researchers: Luca Simione, Salvatore Chiarella
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Estimated duration: 2021/11 – 2024/04

Background: Mindfulness, defined as the non-judgmental, accepting awareness of the present moment, can be cultivated through meditation. This practice focuses on enhancing bodily awareness, mental clarity, and equanimity. Mindfulness profoundly influences interoception, body awareness, and even the perception of personal space. However, the link between this self-centered practice and its impact on social skills remains enigmatic. In fact, the interoceptive and bodily effects are clearly related to the nature of the basic meditation practice, i.e., paying attention to breathing and body sensations, how such a solipsistic practice can affect social skills remains largely unexplained.

Aims: Our study proposes a novel hypothesis suggesting that mindfulness enhances social skills by primarily reshaping body perception and its boundaries. We posit that improved interoceptive abilities, a product of mindfulness meditation, lead to alterations in peripersonal space (PPS) perception. This transformation of PPS, the spatial domain where social interactions occur, is hypothesized to influence how individuals relate to others and their surrounding personal space. Our framework aims to bridge the gap between body awareness, interoception, and social aptitude, with PPS as the intermediary. We explore the static and dynamic effects of meditation on PPS extent.

Method: We conducted two experiments to investigate our hypotheses. In both studies, we evaluated PPS extension using the audio-tactile task developed by Serino and colleagues and personal space boundaries using either the stop-distance procedure or a simplified computerized version. These assessments were performed before and after a meditation session. In the experiments, we compared data from 20 experienced meditators (Study 1) with 50 non-meditators (Study 2). The second study, in particular, examined the impact of two distinct meditation practices on peripersonal and personal space. We also gathered data on participants' meditation expertise and trait measures such as mindfulness, interoception, and social skills.

Results: Across both experiments, we found that mindfulness meditation dynamically alters PPS only after an active mindfulness session, with no discernible static impact on PPS boundaries. The degree of PPS modification is influenced by both meditation experience, where experts exhibit a more pronounced change in PPS extension and rigidity compared to non-meditators, and the type of meditation. Focus-attention meditation significantly altered PPS, while open-monitoring meditation did not affect non-meditators. Additionally, meditators reported a reduced personal space extension in the stop-distance task, indicating that meditation narrows self-boundaries and allows more room for others.

Conclusions: Our findings partially support our hypothesis, suggesting that mindfulness exerts a "dynamic" influence on PPS and social skills, necessitating consistent practice to maintain its psychological effects. This study advances our understanding of how mindfulness and meditation practices influence our perception of the self and others in a social context.

Keywords: Mindfulness, Meditation, Peripersonal space, Social skills, Interoception

Publications:

Simione, L., Saldarini, F. A Critical Review of the Monitor and Acceptance Theory of Mindfulness. *Mindfulness* (2023). https://doi.org/10.1007/s12671-023-02129-0

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Simione, L., & Chiarella, S. G. (2022). Mindfulness effects on body awareness and peripersonal space mediate its effect on increasing social skills: proposing a new research framework. 18th Annual Conference of the AISC, 15-17 December 2022, Rovereto, Italy.

Simione, L., & Chiarella, S. G. (2022). Exploring the effects of mindfulness on self-awareness and sociality: from self to others, and back. XXX Congresso AIP, 27-30 September, Padova, Italy.

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311/20 – "How body ownership shapes tactile awareness: Inducing phantom sensations and measuring their electrophysiological correlates in immersive virtual reality"

Researchers: Carlotta Fossataro, Valentina Bruno, Alice Rossi Sebastiano, Francesca Garbarini
Institution: Department of Psychology, University of Turin (Italy)
Duration: 2021/04 – 2024/01

Background: Touch is strongly related to the bodily-self, forming the boundary between one's own and others' bodies. Previous studies investigated the relationship between touch and body-ownership (i.e., the feeling that body-parts belong to us) demonstrating that somatosensory experiences arising from the skin are at the root for a coherent sense of body-ownership. Neuropsychological evidence suggests that brain-lesions inducing body-ownership delusions lead patients to feel touches onto another's body, suggesting the potentiality of sensing touches even beyond the own body boundaries.

Aims: Against this background, we focus on the role of body-ownership in gating tactile awareness, asking whether the belief of owning a body part determines the ability to perceive tactile sensations on it.

Method: To this aim, we exploited the Rubber Hand Illusion, inducing a feeling of ownership onto a fake hand, combined with a tactile task. During the experiment, following repeated periods of illusion induction (synchronous and asynchronous), tactile events randomly occurred on either the fake (visual-touch) or the own (real-touch) hand. Through a VAS scale, we collected somatosensory reports related to both visual- and real-touch and, by combining EEG with TMS pulses over S1 contingent upon tactile events, we analyzed the touch-related neural dynamics.

Results: Tactile perception increased at the sight of touches occurring onto the fake (embodied) hand, while it decreased when the own (disembodied) hand was touched. The S1 alpha-band connectivity fully paralleled the diametrical modulation of tactile perception, providing evidence of the neurophysiological blueprint, with an increased alpha-band connectivity at the sight of the fake (embodied) hand being touched and a reduced alpha-band connectivity when the own (disembodied) hand is touch.

Conclusions: Taken together our results demonstrate a body ownership dependent modulation of tactile awareness from both a behavioral and a neurophysiological point of view, unveiling the inner potentiality of our brain to feel touch through sight. This evidence bears potential implications for the development of neuroprosthetic devices and rehabilitative trainings to recover impaired somatosensation.

Keywords: Body ownership, Tactile awareness, TMS-EEG

Publications:

Rossi Sebastiano, A., Bruno, V., Ronga, I., Fossataro, C., Galigani, M., Neppi-Modona, M., & Garbarini, F. (2021). Diametrical modulation of tactile and visual perceptual thresholds during the rubber hand illusion: A predictive coding account. *Psychological Research*. doi: 10.1007/s00426-021-01608-0

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Rossi Sebastiano, A., Ronga, I., Fossataro, C., Galigani, M., Poles, K., & Garbarini, F. (2022). Multisensory-driven facilitation within the peripersonal space is modulated by the expectations about stimulus location on the body. *Scientific Reports*, 12(1), 20061. doi: 10.1038/s41598-022-21469-w

Fossataro, C., Galigani, M., Rossi Sebastiano, A., Bruno, V., Ronga, I., & Garbarini, F. (2022). Spatial proximity to others induces plastic changes in the neural representation of the peripersonal space. *iScience*, 26(1), 105879. doi:10.1016/j.isci.2022.105879

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344/20 – "Title: Evaluation of psychological traits, pain perception and muscular strength in trance experts"

Researchers: Olivia Gosseries, Paul Hollanders, Yannick Lafon, Aminata Bicego
Institution: GIGA Research Center, GIGA-Consciousness, University of Liège (Belgium)
Estimated duration: 2022/01 – 2024/04

Background: Trance is a non-ordinary state of consciousness characterised by a modified awareness of self and environment, and altered somatosensory processing. People who practice self-induced cognitive trance, a westernized practice of trance, anecdotally report decreased pain perception and increased muscular strenght during trance.

Aim: To prospectively evaluate (1) pain perception and (2) muscular strength in a group of participants practicing self-induced cognitive trance.

Method: (1) Painful stimulations were administered in 3 conditions: ordinary consciousness (OC), trance and post-trance. Each condition included 10 min of electrical stimulations during which 60 stimuli were administered with a digitimer, followed by 3 pressures stimulations on the hand with an algometer. Pain intensity, pain unpleasantness and irritability were reported after each condition on a 0-10 scale. Event-related potentials (ERP) were also recorded.
(2) Muscular strength was assessed during OC, trance and post-trance. For each condition, 3 consecutive maximal voluntary isometric contractions were performed for 5 sec, 30 sec apart from dominant leg and arm using dynamometers. For each condition and muscle group, participants were asked to rate the subjective perception of their strength on a 0-10 scale and the perceived exertion with the Borg Rating of Perceived Exertion scale. Statistics were performed using repeated measures ANOVA and results were considered significant at $p < .05$.

Results: (1) 28 participants were included (44±14yo, 22 women, mean of practice 38±45months). Trance was associated with a significant decrease in pain intensity, unpleasantness and irritability compared to OC. Pain intensity and unpleasantness remained lower in post-trance compared to OC. The applied pressure was higher in trance than in OC and post-trance, with no difference between OC and post-trance. Decreased ERP amplitudes were also observed in trance compared to OC.
(2) 27 participants were included (45±18yo, 20 women, mean of practice 32±44months). Muscular strength increased in trance for both arm and leg as assessed with the objective and subjective recordings, compared to OC and post-trance. The perceived exertions decreased during trance compared to the other two conditions.

Conclusions: These results suggest that trance reduces pain and increases muscular strength. These findings may be extended to clinical applications, such as for patients with pain and motor impairments.

Keywords: Trance, Pain perception, Muscular strength, Subjective experience, EEG

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347/20 – "Open-label choice blindness: Exploring the mechanism underlying auto-suggestion"
Researchers: Jeremy Olson, Despina Artenie, Ellen Langer, Jian Kong
Institutions: Department of Psychiatry, Massachusets General Hospital, Harvard Medical School, Boston (USA); Department of Psychology, Harvard University, Cambridge (USA)
duration: 2022/05 – 2023/09

Background: *Choice blindness* (CB) — failing to detect that one's selected choice has been replaced by an alternative — can change attitudes with little resistance. It has been demonstrated across consumer, financial, political, and even moral domains. Studies have shown that *confabulation*, in which participants attempt to rationalise why they made the manipulated choice, is partly responsible for the ability of CB to shift attitudes. However, the mechanism responsible for this attitude change remains unclear.

Aims: Here, we assessed its mechanism by testing whether the deceptive manipulation is necessary for choice blindness to change beliefs. We had two aims: first, to test the necessity of deception in CB, and second, to test how the manipulated attitudes may generalize to related domains.

Method: In this preregistered study, 145 students completed baseline questionnaires and then explained their answers to three items about experiential avoidance (the tendency to avoid negative experiences even though they may be useful). Participants were randomly assigned to one of three conditions. Control participants explained their own original responses, CB participants explained responses that we covertly modified to indicate less experiential avoidance, and no-deception participants knowingly explained hypothetical responses that were similarly modified.

Results: Most participants (80%) did not notice the CB manipulation. Both of the experimental conditions reported lower experiential avoidance beliefs on the manipulated items one week later, but these results did not generalise to related outcomes, including other items on the same scale and related constructs such as life satisfaction and depression. We also did not find large differences between the CB condition and its non-deceptive counterpart.

Conclusions: Given these results, we propose that two separate mechanisms may be responsible for CB-induced attitude change: one due to the belief that the false feedback is one's own (choice-induced preference change) and one due to the process of explaining the feedback whether or not it is one's own (confabulation). Our results show that CB can change specific maladaptive beliefs and that using a non-deceptive version of the paradigm can produce similarly positive changes. Because deception is not needed, CB may have practical or clinical value to change beliefs.

Keywords: Suggestion, Attitude change, Choice blindness, Deception

Publications:
Artenie, D. Z., Olson, J. A., Dupuis, G., Suisman, C. C., Casagrande, S. A. G., Akberdina, S., Roy, M., & Langer, E. J. (2023). Exploring the clinical utility of choice blindness: Generalization of effects and necessity of deception. *Psychology of Consciousness: Theory, Research, and Practice.* https://doi.org/10.1037/cns0000372

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360/20 – "Large scale online testing of psi abilities to identify and test talented individuals"
Researcher: Arnaud Delorme
Institution: Institute of Noetic Sciences, Novato (USA)
Estimated duration: 2021/04 – 2024/04

Background: Identifying psi talent may be critical in producing robust, statistically significant results in psi research. To achieve this aim, we need to test a large number of participants and test them again to assess if the results are reproducible.

Aims: The project has three aims:
1) develop and integrate various psi tasks into a single online platform;
2) develop sophisticated ways of analyzing the data to identify talents;
3) assess test-retest scores of talents to ensure exceptional performance is consistent.

Methods: We collected a large sample online to increase robustness by aggregating psi data over large groups of participants by finding psi talent, a method that was successfully used in the 1970s. We tested participants on 8 online games: a quick remote viewing game, a long remote viewing game, a dowsing game, three card games, a telekinesis bubble game, and a lottery game. We also assessed test-retest reliability.

Results: We successfully collected data on more than 1000 participants in the first phase of the project and tested again 50 participants in the top 200 participants of phase 1. During the retests, we observed some significant results for the quick remote viewing game ($p=0.02$) and bubble games ($p=0.03$), although these results did not survive correction for multiple comparisons.

Conclusion: Although after correction for multiple comparisons, none of the retests was significant, a significant trend suggests some of the psi tasks could identify psi talents that have stable performance in a test and retest protocol. Perhaps with more subjects, this trend would reach significance. A journal article is in preparation.

Keywords: Psi, Extrasensory perception, Paranormal belief, Online

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369/20 – "A trait-and-state analysis of precognitive remote viewing focusing on gender, emotions, and pregnancy status" – only abstract available

Researchers: Julia Mossbridge, Mark Boccuzzi, Kirsten Cameron
Institutions: The Institute for Love and Time - TILT, Sebastopol (USA); Windbridge Institute, LLC, Tucson (USA)
Duration: 2021/01 – 2022/09

Background: We aimed to examine trait/state relationships with precognition using a more efficient design and a larger participant population than in past studies.

Aims: We tested five hypotheses: 1) Feelings of unconditional love support PRV accuracy. 2) Feelings of anxiety reduce PRV accuracy. 3) PRV accuracy is supported by unconditional love in women and anxiety in men. 4) PRV accuracy in women is supported by reproductive hormones. 5) PRV accuracy is supported by interesting targets.

Method: We tested these hypotheses by gathering data from 307 participants under the age of 40. All completed an anxiety and unconditional love survey before performing a brief custom-designed online precognitive remote viewing (PRV) task in which they had to try to describe a photo target that was randomly selected after submitting their description.

Results: Unconditional love supported accuracy on the PRV task (hyp. 1), while feelings of anxiety partially supported PRV accuracy (contrasting hyp. 2). Unconditional love showed no gender difference, but anxiety was related to better performance in women and to worse performance in men (contrasting hyp. 3). Further, women taking reproductive hormones performed no differently from other women (contrasting hyp. 4). Finally, target interestingness supported PRV accuracy (hyp. 5).

Conclusions: This PRV task produced significant results even for untrained individuals, suggesting that it taps robust precognition mechanisms. Further, such a task can be used to probe the influence of emotions and gender, revealing intriguing patterns to examine in future work.

Keywords: Precognition, Remote viewing, Gender, Mood

Publications:

Mossbridge, J. (2023). Precognition at the boundaries: An empirical review and theoretical discussion. *Journal of Anomalous Experience and Cognition*, *3*(1), 5–41. https://doi.org/10.31156/jaex.24216

Mossbridge, J. (2023). Predictive anticipatory activity: How do biological systems pre-spond to future events. In Proceedings of the 13th Symposium of the Bial Foundation "Behind and Beyond the Brain": The mystery of time (pp. 119-147).

Mossbridge, J., Cameron, K., & Boccuzzi, M. (*in press*). State, trait, and target parameters associated with accuracy in two online tests of precognitive remote viewing. Journal of Anomalous Experience and Cognition. https://doi.org/10.31234/osf.io/9zjus

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384/20 – "Schema-based temporal memory in parietal cortex (SCHETEMP)"
Researchers: Matteo Frisoni, Paolo Capotosto
Institution: Department of Neurosciences, Imaging and Clinical Sciences, Università degli Studi G. d'Annunzio Chieti – Pescara (Italy)
Duration: 2021/10 – 2023/11

Background: The ability to organize events in time is a hallmark of episodic memory. Prominent fMRI studies have shown that the entorhinal-hippocampal network is involved in judging precisely the time of occurrence of episodic memories and in representing the temporal structure of the event. However, little is known about the relationship between these two processes and their temporal characteristics.

Aims: The present EEG study investigated whether the neural correlates of temporal memory precision and event structure are related, whether they occur during stimulus encoding, memory decision or response execution, and whether they are distributed also outside the entorhinal-hippocampal network.

Method: Twenty volunteers reported the time of occurrence of short video clips extracted from a previously encoded movie on a horizontal timeline representing the movie duration. This procedure provided measures of temporal memory precision and perceived temporal distance between stimuli extracted from distinct movie parts. A multivariate pattern analysis (MVPA) of the time-frequency data was used to classify trials associated with low, medium and high precision. A representational similarity analysis (RSA) was used to investigate the similarity between behavioral and neural distance associated with pairs of movie parts.

Results: Using MVPA, we found an electrophysiological signature of temporal precision in the high beta/low gamma band (28-40 Hz) during presentation of the timeline, extending outside the entorhinal-hippocampal network. An independent RSA of spatially distributed activity revealed a strong coupling between behavioral and neural distance related to pairs of movie parts at the same time and frequency band compared to the precision effect. Crucially, we found that subjects showing higher temporal precision were those who also exhibited a stronger correlation between behavioral and neural distance.

Conclusions: We found that oscillatory activity in the high beta/low gamma frequency codes for both temporal memory precision and the representation of event structure. These effects occur simultaneously after stimulus presentation but before the manual response and extend beyond the MTL, suggesting that temporal memory is supported by a distributed cortical network. These results help to link different phenomena reported in the literature on temporal memory and shed new light on how complex events in our life become "infused with time".

Keywords: Episodic memory, Memory for time, Temporal representation, Temporal memory precision, Beta/gamma band

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The Proceedings that are now being published include the lectures of the 14th Symposium "Behind and Beyond the Brain" dedicated to "Creativity". It also includes the abstracts of some of the research projects supported by the BIAL Foundation and presented at this meeting in poster sessions and oral communications. The online version of these abstracts is available at www.bialfoundation.com.