Bridge for Brains

Dr Caroline Small, Honorary Senior Lecturer at Imperial College, London,
and Trustee, English Bridge Education and Development

How the brain works

The increasing life span of people living in the UK is cited as a triumph of the last century (Parliament, 2016). As life expectancy increases and birth rates decline there is a shift in the proportion of older people, with an estimated one in four people aged 65 and over by the year 2030 (Rutherford, 2011). As we age the quest for maintaining good health across the decades becomes increasingly important. EBED is investigating 'brain health' and finding ways of supporting 'healthy ageing' through promoting cognitive activities such as playing bridge.

The brain is a complicated and fascinating organ, made up of over 100 billion neurons communicating messages to each other (Herculano-Houzel, 2009). Previously, it was believed that the brain structure was fixed at childhood with minimal flexibility later in life (Miniussi and Vallar, 2011). However, recent research into cognitive ageing and advances in neuroimaging, demonstrate the dynamic and adaptive nature of the human brain as it ages (Park and Reuter-Lorenz, 2012; Boyke et al., 2008; Reuter-Lorenz and Lustig, 2005). Of particular interest to us is the concept of 'neuroplasticity', which describes "the ability of the nervous system to change its structure and function, as part of the processes that underlie learning and memory, to adapt to environmental changes, and to recover function after brain lesions" (Miniussi and Vallar, 2011: 554). In short, our brains remain flexible to learning across the life course and we hypothesise that playing bridge enhances and maintains this flexibility.

As the brain ages there will be changes and slowing of particular functions including: changes and loss of neurons, reduced blood flow, and shrinkage in areas such as the prefrontal cortex (National Institute of Aging, 2008). Growing research into neuroplasticity does not intend to contradict this; rather it highlights how this loss of function does not always equate to progressive decline (Cabeza et al., 2002). The question posed to neuroscientists is therefore not why we get cognitive decline as we get older, but how do

older adults continue to function well in light of these declines (Goh and Park, 2009). Moreover, playing bridge may be protective to this decline.

It is suggested by Park and Reuter-Lorenz (2009) that the declining function triggers a homeostatic response , i.e. the body attempts to balance the decline through reorganisation and repair. The ensuing strengthening of connections, disuse of weak or faulty connections, and formation of new connections is termed 'scaffolding' (Park and Reuter-Lorenz, 2009). Figure 1 illustrates a simplified version of this process. If we imagine that there is a clear pathway in our brain from circle to rectangle, over time this pathway can become interrupted, whether that is through a weakening in the connection or the introduction of an obstacle. Despite this, the rectangle still exists; therefore, 'scaffolding' seeks to find new ways of gaining access to this information.

Figure 1: The process of scaffolding in the context of neuroplasticity

The nature of the obstacle may alter the brain's ability to compensate for it; however, it begins to highlight the flexibility of the brain and connections within it. Interestingly, the process of 'scaffolding' is not unique to cognitive decline, but is suggested to occur across the lifespan in response to cognitive challenges (Park and Reuter-Lorenz, 2009). In children and younger adults this process is about strengthening the primary connections, i.e. making the route from circle to rectangle in Figure 1 more robust. Whereas, as we age and these connections weaken, a secondary route is needed that, although less efficient than the first route, enables us to reach the same end point (Goh and Park, 2009).

The scaffolding theory of ageing and cognition supports the idea that engaging in novel tasks or environments, or cognitive training, can enhance the development of compensatory scaffolding. Ultimately this could lead to protection of cognitive functioning

(Park and Bischof, 2013). We hypothesise that bridge strengthens the primary connections and promotes the development of secondary routes.

Study 1: Does bridge increase wellbeing?

There is a commonly held view that those playing bridge beyond the age of 60+ tend to remain alert into their 80s and 90s. There is no doubt that serious bridge playing requires higher cognitive processes associated with the frontal areas of the cerebral cortex. However, there is little scientific investigation of the topic.

Bridge could have a direct positive effect on the neuronal function of an individual. As discussed above bridge could strengthen and initiate primary connections in the young and allow the brain to develop secondary routes as it ages. In order to examine this further, we hypothesised that bridge could:

1) Directly develop and maintain the neuronal pathways in the brain. This occurs primarily as a biochemical process in the brain driven by the physical mental activity required to play bridge.
2) Enhance the feeling of well-being in individuals. That bridge increases the purpose of life as one ages, increases the social interaction an individual has, and decreases the feeling of isolation.

Recent research has demonstrated that individuals taking up membership of a club at retirement live longer. In order to examine the role of bridge on an individual's well-being EBED has undertaken a study in collaboration with the University of Stirling.

To investigate the association between playing bridge and various indicators of wellbeing, an online questionnaire was developed to capture demographic, social, subjective wellbeing, and bridge playing characteristics of individuals. The survey method was selected as a productive and robust way of quantitatively capturing both characteristics and perceptions of respondents (May, 2011). Questions relating to demographic, social and wellbeing domains were chosen from a subset of the questions contained in Wave 6 of the English Longitudinal Study of Aging (ELSA).[1] ELSA is a published peer reviewed longitudinal

[1] The complete set of questions used in this survey can be viewed, along with the dataset itself, at the following site: *Link to DataSTORRE desposit of data and survey.*

survey of a representative sample of individuals in England aged 50 and older. Wave 6 was conducted in 2012 and captured information relating to the health, social, wellbeing and economic circumstances of 10,601 individuals.[2] The population of interest in this study was bridge players and their non-playing counterparts. The questionnaire was mainly disseminated to bridge players in the UK via the EBU website, with a small number of international and non-bridge playing individuals captured in the sample. We were overwhelmed by the response to the questionnaire and received over 7000 responses and would like to thank all the participants of the study.

In order to examine what factors account for variation in average wellbeing, we developed a statistical model using linear regression. We modelled an individual's wellbeing score as a function of age, sex, retirement status, whether they have a higher educational qualification (i.e. degree or higher), the presence of a partner with whom they live, membership of a social network, ability to socialise when they feel like it, and whether or not they play bridge.

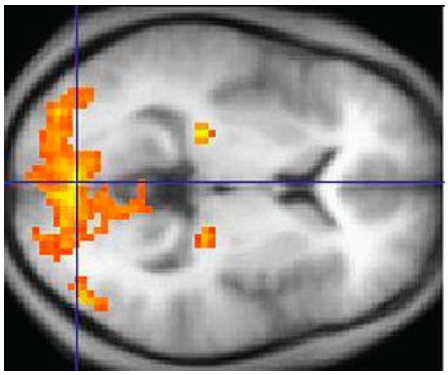
The results of the model suggest that individuals who play bridge have higher levels of overall wellbeing; on average playing bridge is worth an additional 1.48 points to an individual's score. Importantly this is net of the other factors in the model and this figure is statistically significant, implying that this finding is unlikely to have resulted by chance. Perhaps unsurprisingly, the ability to socialise when an individual feels like it has a larger effect on wellbeing. Females have higher wellbeing scores compared to males, as do those living with a spouse of partner. Interestingly the effect of bridge on wellbeing is higher than the effect of female vs male, or the effect of living with a spouse or partner. The full findings of this research are available at www.ebedcio.org.uk/files/docs/research/individual-wellbeing-and-bridge-an-empirical-analysis.pdf

Our initial research has demonstrated, for the first time, that playing bridge has a statistically significant positive effect on wellbeing.

[2] Further information on the study, including question modules and sample design, can be found at: http://www.elsa-project.ac.uk/about-ELSA.

Do bridge players have altered brains?

Following our first successful study we now wish to examine if long term bridge playing directly alters the structure and functioning of the brain. We will recruit fifteen bridge players and fifteen appropriate controls (aged 65-75) and perform Functional magnetic resonance imaging or functional MRI (fMRI) at Imperial College, London. fMRI is a functional neuroimaging procedure using MRI technology that measures brain activity by detecting changes associated with blood flow. This technique relies on the fact that cerebral blood flow and neuronal activation are coupled. When an area of the brain is in use, blood flow to that region also increases.



The image above shows an fMRI image with the yellow areas showing increased neuronal activity. fMRI imaging will be used to examine the brains of bridge players and how they may differ from matched controls. Would a bridge player access and utilise different areas of the brain when memory tasks are performed? The brains will be examined in the baseline state, undertaking a cognitive task and with no stimulation. We hypothesise that the scans of bridge players will be altered in areas of the brain associated with reasoning and problem solving.

This work will have benefits to the wider society and demonstrate how bridge alters and preserves brain function. We aim to demonstrate that bridge has a positive effect on neuronal function by maintaining and enhancing neuronal connections. These results would promote the health benefits and encourage new players into the game. A delay in the onset of the ageing process by an average of just one year, or a modest 10-15% improvement in mental awareness, has considerable benefits to society. It would generate considerable direct health cost savings in addition to enhancing the quality of life of the population.

EBED has kindly allocated £20,000 of its charitable funds to undertake this study. This will allow us to begin and we are seeking support from the bridge playing community to donate the balance of the money (£40,000) we need to complete the work. If you would like to support this research, please donate now – www.ebedcio.org.uk/donate.