A review of possible interventions into healthy ageing and cognitive stimulation:

Exploring the links between Bridge and dementia

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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). Although in many ways this shift is a celebration of advances in healthcare, it does not come without challenges. As people age they are at higher risk of complex co-morbidities and disabilities (Oliver et al., 2014), which is associated with escalating economic costs (WHO, 2011). This leads to increased incentive to find ways of helping people to maintain good health across old age. Of particular interest to this review is 'brain health' and finding ways of supporting 'healthy ageing' through promoting cognitive activities. There is significant overlap between discussions relating to the ageing population and to 'brain health' due to the increased risk of dementia as we age (WHO, 2011).

The following review synthesises literature relating to 'brain health' to consider whether activities such as the card game of Bridge can promote healthy ageing, and whether the age at which you take on such skills may influence the outcome. Further, if Bridge is able to promote cognitive health, could it help to prevent or delay the onset of dementia, or improve the well-being of those diagnosed with the condition? Given the limited research focusing specifically on Bridge and Dementia, a range of comparative activities have been considered.

Neuroplasticity of the brain

The brain is a complicated and fascinating organ, made up of over 100 billion neurons communicating messages to each other (Herculano-Houzel, 2009). The complexity of the brain makes it an incredibly difficult organ to research, particularly when the neurophysiology of the brain is considered alongside the role of psychological and social factors. Historically, researchers learned about the brain through observing the impact of damage (Rathus, 2007), however, in recent years, advances in neuroimaging techniques have allowed scientists to learn more about typical and atypical brain composition and function (Bandettini, 2009). Of particular interest to this review 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, do our brains remain flexible to learning across the life course? Previously, it was believed that the brain structure was fixed at childhood, and therefore suggests minimal flexibility later in life (Miniussi and Vallar, 2011). This may be reflected in myths about ageing such as, ‘older people can’t learn new things’ (Erber and Szuchman, 2014). However, following the integration of psychosocial research into cognitive ageing and advances in neuroimaging, research is increasingly highlighting 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).

As the brain ages there will undeniably 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 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). It is suggested by Park and Reuter-Lorenz (2012) that the declining function triggers a homeostatic response i.e. the body attempts to balance the effects 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, 2012). 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). Theoretically this has important implications for older adults and people at risk of dementia, with the Alzheimer's Association (2015) noting that if an effective treatment could delay the onset of dementia by 5 years, it could reduce the number of people with the condition by over 40 percent. Despite the potential for positive outcomes, it should be noted that there are still major gaps in understanding over the conditions needed for healthy older brains to instigate the scaffolding process (Park and Bischof, 2013).

One of the suggestions regarding the effectiveness of scaffolding is cognitive reserve. Cognitive reserve within the field of brain injury or neurodegenerative disease refers to a disparity between the clinical manifestations of a person and their level of brain damage (brain pathology). This is illustrated by people who show significant pathological brain degeneration consistent with that of Alzheimer's disease on autopsy, yet they do not present with symptoms of the condition while living (Stern, 2009). Understandings of cognitive reserve suggest there are individual differences in how people complete tasks, due to differing degeneration. Unlike scaffolding which occurs across the lifespan, cognitive reserve is discussed as something that only comes into play when the brain is trying to compensate for damage. Stern (2002) suggests that when the brain can no longer use the connections it used before, it will use structures or networks that were previously unused.

Factors such as socioeconomic status are cited as possible determinants of cognitive reserve, particularly due to education levels. People from lower socioeconomic status are more likely to have lower education levels (this is often used as a socioeconomic status marker on its own (Duncan et al., 2002)); as a result they are likely to have less cognitive reserve (Meng & D'Arcy 2012). This will manifest as a slower decline than those with higher socioeconomic status. The slower decline may sound counter-intuitive, but in practice it means that people with more reserve are managing longer without displaying cognitive problems, so that when these mechanisms 'run out' the decline appears very rapid. The current work on cognitive reserve hypothesis warns of the potential vulnerability of people from lower education but also opens up a wealth of opportunities for interventions to increase individual's reserve and compensatory mechanisms. Recent research adds further support to the importance of 'brain reserve' illustrating that increased reserve is associated with lower risk of developing dementia (Borenstein et al., 2014).

In order to consider whether neuroplasticity and cognitive reserve can be manipulated by external factors, examples from the field of music and cognition should also be noted. Importantly, musical training as a multisensory and motor experience has been shown to influence brain plasticity (Hyde et al., 2009). In a study by Hyde et al. (2009), brain images of children who learned the keyboard for 15 months were compared with a control group of children (i.e. children who were of similar demographics but did not learn a musical instrument). They found significant structural brain differences between the two groups of children that were not seen at baseline i.e. changes were not due to a biological predisposition to music, but were a result of musical training across the 15 months. When considered in light of the positive psychosocial outcomes from musical interventions, such as improved quality of life (Vasionyte and Madison, 2013; Raglio et al., 2014; Lee et al., 2010), these findings offer potential for future interventions that consider activities where neurological and psychosocial outcomes can be achieved together.

In addition, and of particular importance to this review, recent research suggests that playing a musical instrument is not just of benefit to younger people. Balbag et al. (2014) recently conducted a population-based twin study in Sweden, where the focus was on discordant-musician twins i.e. where one twin plays a musical instrument and the other does not. They found as high as 64% lower likelihood of dementia when comparing the musical and non-musical co-twins (Balbag et al., 2014). Although the findings should be treated cautiously, as they are based on associations rather than causal factors, the study demonstrates the positive influence of neuroplasticity, independent of age a person begins to play an instrument (Balbag et al., 2014). Furthermore, the findings emphasise the adage that it is ‘never too late’ to engage in new activities and influence cognitive capabilities. However, musical instruments generally require a certain degree of physicality and dexterity (Schmidt Peters, 2006; Wright, 2016) which may reduce the numbers of older people who can engage with them (Voelcher-Rehage and Alberts, 2007; Clark and Manini, 2008). Alternatives such as Bridge, which offer cognitive challenges and reward with an essential social element, may offer a more suitable alternative for encouraging ‘brain health’ in older adults.

Overall, the literature relating to neuroplasticity, scaffolding, and cognitive reserve suggests that the brain is able to adapt to new circumstances, and compensate for changes associated with aging and potentially dementia. Further, the continuous process of learning and cognitive reorganisation suggests potential to strengthen connections and increase cognitive reserve across the lifespan. Therefore, this review will go on to consider whether activities such as playing Bridge could enhance this process. Before focusing on cognitive activities, an overview of dementia is provided, given that the discussed findings offer the potential to delay the disease onset or speed of progression.

What is dementia?

Dementia is an umbrella term which encompasses a range of neurodegenerative diseases. Symptoms of dementia include memory loss, difficulty with problem solving, and difficulty in communicating. Dementia is progressive, leading to increasing symptoms over time (Alzheimer’s Society, 2015). Despite the symptom trajectory it is worth noting that a person's quality of life does not follow the same path, many people living with dementia continue to experience high quality of life (Missotten et al., 2008; Selwood et al., 2005).

Statistics indicate that around 850,000 people are living with dementia in the UK (Alzheimer's Society, 2016). The number of people with the condition is expected to continually rise due to the ageing population, as noted in the introduction. The greatest risk factor for dementia is age, however, it is important to note that around 40,000 younger people are living with dementia in the UK (<65 years old). Although there is not a significant gender difference in terms of risk of dementia (Ruitenberg et al., 2001), the difference in average life span, with women in the UK living on average three years longer than men (Office of National Statistics, 2015), leads to a 2:1 ratio of women to men with dementia (Dementia Consortium, 2016).

There are many different types of dementia; broadly speaking they differ based on the region of the brain they affect and consequently the prevalence of particular symptoms. The following section outlines some of the more common types of dementia.

Alzheimer's disease

Alzheimer's disease is the most common type of dementia for both younger and older people. The brain degenerates due to the accumulation of 'tangles' and 'plaques' and the most common symptoms are memory loss, language difficulties, problems with planning and organising, and orientation.

Vascular dementia

Vascular dementia is a result of damaged blood vessels leading to reduced blood flow to different regions of the brain. Symptoms include problems planning, slower speed of thought, problems with concentration and difficulty following a series of steps.

Fronto-temporal dementia

Fronto-temporal dementia has a greater impact on personality and behaviour over memory and can lead to reduced inhibitions; as a result this type of dementia may have greater impact on social interactions.

Lewy-body dementia

Lewy-body dementia has many overlaps with Parkinson's disease and people can have problems with attention, alertness, and increased likelihood of hallucinations (Alzheimer's Society, 2016b).

Understanding the different types of dementia is important when designing research into the disease due to different ways the condition can impact on people's daily lives. For instance, behavioural and psychological symptoms of dementia (BPSD) including agitation, sleep disturbances and wandering, are likely to affect 90 percent of people with dementia to some degree (Liperoti et al., 2008), with BPSD cited as a key factor in caregiver burden (Beeri et al., 2002). Within this, type-specific BPSDs have been noted such as hallucinations and Lewy Body dementia, anxiety in people with Alzheimer's disease, and emotional disturbance in people with vascular dementia (Chiu et al., 2006). Although the symptoms are not necessarily type-exclusive, it demonstrates the importance of type-awareness when considering interventions. In addition, the type of dementia may influence the feasibility of interventions and how effective they may be. For instance, pharmaceutical interventions into Alzheimer's disease are increasingly prioritised; whereas, the same treatments are not necessarily suitable for people with fronto-temporal dementia (Alzheimer's Society, 2013).

Before moving on to the risk factors of dementia, it is worth noting an additional condition which is often placed under the umbrella term of dementia, known as Mild Cognitive Impairment (MCI). Mild cognitive impairment sits between 'normal ageing' and Alzheimer's disease and describes people with cognitive impairment but not functional (Wenisch et al., 2007). Between 3-13% of people diagnosed with mild cognitive impairment will go on to develop dementia each year (Tomaszewski Farias et al., 2009). The percentages offered vary across papers because the boundaries are very unclear between mild cognitive impairment and early dementia, which makes it difficult to make a definitive diagnosis. Importantly for this review are the findings of Wenisch et al. (2007), who discuss evidence for cognitive reserve and the continued ability of the brain to adapt even in circumstances of cognitive impairment. Although the study is small, it reinforces the direction of future study in activities and the malleability of neurological connections.

What are the risk factors for dementia?

The biggest risk factor for dementia is age; however, it is distinct from ‘normal ageing’. Neuro-degeneration is expected as we age, but this in itself does not result in dementia. In previous research, such as Sonnen et al. (2011), significant beta-amyloid build up was seen in 25-50% of cognitively ‘normal’ brains. This is somewhat surprising as beta-amyloid is associated with Alzheimer’s disease (Stern, 2002). The findings of Sonnen et al. (2011) emphasise the separation between neuro-degeneration, age, and the development of dementia. Despite the neurological distinctions set out by Sonnen et al. (2011), the boundary between early stages of dementia and physiological ageing remains unclear (Derouesne, 2002). Importantly, the noted lack of clarity contributes to the challenge of knowing when to intervene.

The increased risk associated with age can be attributed to several factors including higher blood pressure, increased likelihood of illnesses such as stroke, changes to cell structure and the immune system, and weakening of the body’s ability to repair itself over time (Alzheimer’s Society, 2016c). Age is a risk factor we cannot change, however, there are lifestyle related factors and health indicators that may also help predict risk of dementia and can potentially be modified. Higher risk is associated for people with diabetes, hypertension, and stroke (Borenstein et al., 2014). In addition, dementia and depression have a significant relationship with each other (Saczynski et al., 2010), although it is unclear whether it is a risk factor or an early symptom of the condition. Recent research suggests it may be dependent on the time of onset of depressive symptoms (Barnes et al., 2012).

Finally, it is important to note that there are genetic risk factors for dementia, however, there is a great deal of unknowns; having a family member with the condition does not necessarily increase chances of getting dementia. A number of genes have been suggested to affect people’s risk of the condition but are not the cause, such as APoE3. There are more directly causal genes associated with the very rare cases of dementia; however, in general the genetic risk factors associated with dementia are minimal when compared to the risk of age (Loy et al., 2014).

Is dementia preventable?

Several factors have been identified for reducing the risk of dementia including regular exercise, healthy weight and balanced diets, healthy cholesterol and blood pressure, and moderating alcohol intake (ARUK, 2015). Most of these recommendations are based on the overlapping risk factors between cardiovascular health and dementia. Recent recommendations also draw attention to the type of activity people engage with, illustrating that social and mental activity may reduce the risk of developing dementia (Alzheimer's Society, 2016c). In support of these recommendations, Verghese et al. (2003) found that leisure activities such as reading, playing board games, dancing, and playing musical instruments were associated with a lower risk of dementia than physical activity. Interestingly, the authors highlight that the activity may increase cognitive reserve. In support of this, Scarmeas et al. (2003) found that people who get more involved in activities such as arts and crafts, reading, playing cards etc. show a greater degree of brain pathologic involvement. If this acts to buffer the effects of dementia, then interventions could be developed. Leisure will be discussed in more detail in the final section of the review.

More recently, Klimova and Kuca (2015) reiterate the potential for preventative, non-invasive, intervention strategies for reducing risk of cognitive decline. As illustrated in Figure 2, strategies include physical activities, cognitive activities, and dietary changes. It is not within the scope of this review to consider the evidence for all of these, however, it reinforces that cognitive training may be of benefit, and that this could take several forms e.g. playing an instrument, learning a language, playing the card game Bridge. Of note, missing from the Klimova and Kuca (2015) figure is social activities, which is surprising given the potential importance of social relationships (Holt-Lunstad et al., 2010), as will be discussed in more detail further in the review.

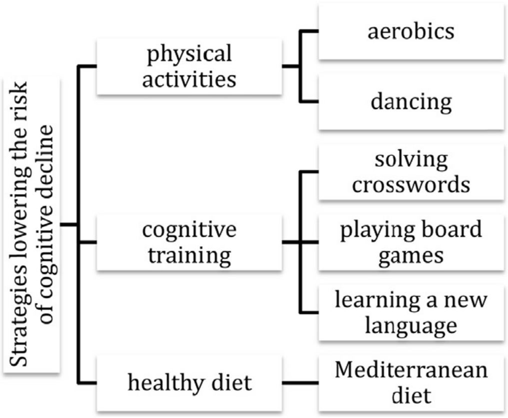

Figure 2: Potential preventive, non-invasive, intervention strategies for cognitive decline (Klimova and Luca, 2015)

So far, the literature presented that relates to dementia illustrates that there are several types of dementia and that can affect people in various ways. Both older and younger people can develop the condition, but increasing age is the greater risk factor. In many ways the literatures demonstrates that people have very little control over the onset and progression of dementia. With regards to neuroplasticity, scaffolding and cognitive reserve, the literature suggests potential for future research into interventions which improve this. Of particular importance to this review is cognitive activity as a psychosocial intervention.

Does cognitive activity influence dementia?

The National Institute on Aging (2012b) provides several reasons why an active brain may prevent Alzheimer’s disease. Firstly, as noted previously, they may establish cognitive reserve and allow the brain to be more adaptable and compensate for disruptions in function. Additionally, people who participate in socially engaging or intellectually stimulating activities may be more likely to have other protective lifestyle factors. As with the unclear relationship between depression and dementia, it may also be that lack of engagement in such activities is a result of early effects of dementia instead of a causal factor.

Although the links between cognitive activity and dementia may be unclear, a recent study by Bowes et al. (2012) notes that dementia prevention was a motivating factor for undertaking such activities. Interestingly, the researchers note that engaging in ‘dementia prevention' activities may increase people's stress levels, which may in turn increase their risk of dementia (Wang et al., 2009). Further, it may be more beneficial for people to participate in activities for enjoyment and relaxation (Bowes et al., 2012). Noteworthy for this review, for those who played games such as Bridge, darts and dominoes, the majority cited enjoyment and relaxation as their main motivation, with dementia prevention rating lowest.

In addition, Bowes et al. (2012) discuss the challenge of 'brain training' games and the clouded evidence surrounding their effectiveness. This is an issue that has lead to much debate. The caution around 'brain training' software is not necessarily concerns over the benefit, rather, that the way the activity is marketed is based on unsubstantiated claims and a lack of scientific evidence (Stanford Center on Longevity, 2014). The criticism of 'brain training' does not mean that it is ineffective, but that the level of effect is varied and needs a more robust evidence base. Lampit et al. (2014) found that 'brain training' may produce small but significant improvements in cognitive functioning of older adults, however, several factors were important within this including: the design of the game, and completing the game within training sessions rather than alone. The findings reiterate the importance of social interaction and add further support for activities such as Bridge which are multiplayer.

Thus far, the focus of this review has largely been the brain itself and how it works. The following section considers how different activities may influence people's well-being, with a particular focus on Bridge throughout. Firstly, the review questions what makes an activity meaningful, and does it influence the effect the activity has? This leads on to evidence around interventions which utilise meaningful activities, and lessons to be learned from music and memory research. Finally, the review concludes with recommendations for future research into Bridge and 'brain health'.

Meaningful activities and Dementia

According to NICE[1] guidelines, a meaningful activity is one that "includes physical, social and leisure activities that are tailored to the person's needs and preferences… Activity may

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[1] The National Institute for Health and Care Excellence (NICE) provide a variety of frameworks and guidance to support health and social care, one of which focuses on mental well being of older people in care homes (Nice, 2013)

provide emotional, creative, intellectual and spiritual stimulation" (NICE, 2013: 17). The opportunity to engage in meaningful activity is the first of six quality statements for people living in care homes (NICE, 2013). Of interest to this review is whether meaningful activities are of benefit to people with dementia, and if so, could Bridge be categorised as a meaningful activity that could have positive outcomes for people with the condition. Importantly, the NICE (2013) definition focuses on a person's preferences, reinforcing that meaningful activities are likely to be those that fit with a person's identity (Vernooj-Dassen, 2007).

The research into meaningful activities acknowledges the importance on honouring people's identity, and finding ways of providing cognitive and social simulation that fits with this. In this regard, it may be that the interaction between Bridge and Dementia is most important for people with dementia who are currently or have previously been Bridge players. In this case, the memory focused features of Bridge are discussed, to see whether continuing to play Bridge with dementia would remain a positive experience.

Bridge involves transferring memory from short-term memory to long-term memory (Engel and Bukstel, 1978) a process that may be particularly difficult for people with dementia (Miller, 1973). Engel and Bukstel (1978) note that Bridge offers unique insights into memory due to the importance of working memory to succeed in the game; this may also raise challenges for people with dementia as the condition impairs working memory (Kensinger et al., 2003).

'Working memory' refers to the way the brain manipulates information in short term memory to allow people to perform complex tasks (see Baddeley, 1992). Working memory is not unitary, and recent research suggests there may be differences between Alzheimer's disease and other types of dementia in terms of working memory impairments (Sala et al., 2012). This has potential implications for whether people with dementia would be able to play or learn Bridge, and whether the type of dementia they are diagnosed with influences this.

The research seems to suggest that Bridge may not be a suitable intervention for people living with dementia, as it is a difficult game to learn and play. However, it may not be an all or nothing situation, the fact that Bridge involves memory, social interaction and leisure, may make it a beneficial activity for people to engage with, particularly at a non-competitive level. Comparatively, it may be that experienced Bridge players who develop dementia may be more affected by the change in ability to play at the same level, particularly if being a Bridge player is an important aspect of their identity as this could feel a significant loss. In spite of this potential loss, people who identify themselves as Bridge players may be able to slow the progression of dementia by continuing to be active in the game.

The conflicting possibilities within the discussion reinforces that there is not a clear answer to whom playing Bridge could be beneficial to, and whether playing the game following the development of dementia would be a positive or negative experience. The research discussed is fairly dated and would be worth considering with the more up to date knowledge we have about the brain, dementia, and the importance of cognitive simulation. Furthermore, there is a potential shift in research in recent years towards prevention which would suggest intervening in younger age groups or targeting the ‘worried-well’ may also be beneficial.

A final consideration is whether Bridge could work as an activity that supports people with cognitive difficulties, within a wider supportive programme, such as cognitive stimulation therapy: Or, whether the success of cognitive stimulation therapy justifies further exploration of activities that would produce similar outcomes.

Cognitive stimulation therapy

Cognitive stimulation therapy is a 14-session treatment programme which is conducted in a group and targets cognitive and social functioning (Spector et al., 2010). The therapy has grown in popularity over recent years, as one of the only psychosocial interventions recommended within NICE guidelines (NICE, 2006), and showing similar effectiveness to currently available drugs (Spector et al., 2003). Activities across the 14 sessions include physical activities, word and number games, orientation, and being creative (CST, 2016). The overall aim of the sessions is to improve cognition and behaviour (Spector et al., 2001). The evidence available thus far suggests cognitive stimulation is able to meet these aims and improve quality of life (Woods et al., 2006), as well as other aspects of well-being, in particular social communication (Aguirre et al., 2013; Spector et al., 2010).

This is not to say that cognitive stimulation therapy is the answer to treating dementia, or that we should not be using pharmaceutical products if they have the same level of impact as the therapy. Rather, the findings suggest there is real promise in the area of psychosocial interventions to improve people's quality of life while the drugs available are limited, and we should explore the potential of cognitive activities in improving outcomes for people with dementia. Matsuda (2007) suggests that cognitive stimulation therapy and acetylcholinesterase inhibitors (medication available to help Alzheimer's disease) should be used together for the best outcomes.

Generally, cognitive stimulation therapy is discussed in terms of mild-moderate dementia, which refers to the degree of symptoms a person with dementia is experiencing. Recent evidence demonstrates that positive impacts can also be seen in people with Mild Cognitive Impairment (Wenisch et al., 2007), further suggesting cognitive interventions should be considered before dementia develops.

Bridge and Identity

Within meaningful activities, identity was raised as an important aspect of activity preference. In order to consider the impact of identity, dementia and Bridge, some background literature on identity and the self will be discussed across the following section. Of note, these are broad, complex topic areas across psychology and sociology, therefore this review intends to focus on key aspects that may influence Bridge players.

Self and identity relate to a social process which evolves over time in light of the biological changes associated with a particular illness (Kelly and Field, 1996): in short, how illness affects someone's feelings about themselves, or how others view them. In recent years, several studies have explored identity and dementia with some notable findings. Caddell and Clare (2013) considered the relationship between cognitive abilities and identity, and found a complex non-linear relationship between cognitive decline and identity deterioration in people with early-stage dementia (Caddell and Clare, 2013). Essentially this means that progressive symptoms do not result in a person's identity being lost at an equal rate. Based on particular cognitive tasks, Caddell and Clare (2013) revealed that difficulty communicating influenced a person's sense of identity. These results tie into early literature on the self and identity, in terms of how social interactions with others shape a person's identity. If people have difficulty communicating, this can intrude on interactions (Kelly and Field, 1996).

Despite the increasing amount of literature to support preserved identity in people with dementia, the strength of the label 'dementia' can lead to people being defined in terms of their condition alone, representing a 'master status' which subsumes all other attributes into one stigmatised identity (Goffman, 1963). As well as the challenges faced from public reactions towards dementia, people diagnosed can internalise these attitudes, leading them to view themselves negatively (Milne, 2010).

When people are faced with chronic illness, one of the ways of managing the impact it can have on identity is to create new identities based on the situation they are in (Conrad and Barker, 2010). Illness identities involve the person taking on aspects of their condition as part of themselves, and can be seen in examples such as people with cancer, who identify themselves as 'cancer survivors' (Kaiser, 2008). This movement can not only lead to changes in their own identity, but in formation of group identities which aim to emphasise that people are not passive to their condition (Conrad and Barker, 2010). Positive outcomes from building a shared social identity have been evidenced in studies with people with Alzheimer's disease (Clare et al, 2008). Further research is needed to explore the benefits of shared social identity, particularly in terminal and progressive conditions, where people will be exposed to possible futures, as well as social support.

So, how does this relate to Bridge? The research into identity and the self is a huge field of study, which has not been explored in detail here. However, we do know that people with dementia are able to preserve certain aspects of their identity, and build new identities in the face of negative circumstances. Therefore, it may be possible for people to develop a new identity as a 'Bridge player' and use this new identity to harness positive social interactions, and cognitive stimulation.

There are two possible scenarios for people who already play Bridge and see this as an important part of their identity. Either, they can be supported to continue playing Bridge, and this will act as a meaningful activity which has been shown to have positive outcomes. Alternatively, if dementia leads to difficulty in playing the game due to the use of working memory, people may find it very difficult to maintain this identity and withdraw. This would lead to reduced cognitive stimulation, and reduced social stimulation, all of which can lead to negative outcomes if new identities are not developed.

Patrick and Bigwall (1987: 207) note, competence is an important part of activity-identity,

> "We become racquetball players, golfers, Bridge-players, and mountain climbers both for the personal satisfaction we derive from these activities and for the social interactions based on them and the identities that are created by the competent performance of them."

The quote highlights the importance of the activity itself, social interactions and ability. If someone feels their ability is compromised, it will become harder to hold on to the previous identity, resulting in a need for change.

A recent newspaper article in the New York Times (Carey, 2009) provides anecdotal evidence of the importance of competency. The article follows the experiences of older adults living without dementia. The increasing number of people reaching this age group with minimal memory deterioration provides insights into what factors may support memory. The article focuses on the group playing Bridge; the quote provided by Julie, a Bridge player, highlights the challenges previously discussed:

> "When a partner starts to slip, you can't trust them… That's what it comes down to. It's terrible to say it that way, and worse to watch it happen. But other players get very annoyed. You can't help yourself." (Carey, 2009)

Similarly, the quote from Ms Cummins highlights that this can lead to people withdrawing

> "A friend of mine, a very good player, when she thought she couldn't keep up, she automatically dropped out… That's usually what happens." (Carey, 2009)

Although the quotes are from non-research based studies, they highlight some of the challenges that people may face that warrant further explorations. Work on managing a diagnosis of dementia highlights that people have to perform a balancing act between maintaining who they were before diagnosis, and who they are with the symptoms of the condition (Keady et al., 2009). There remains a challenge where people wish to participate in activities that rely on memory.

Leisure activity and constraints

Thus far the previous sections have discussed the importance of meaningful activities for people with dementia, and the potential for Bridge to be meaningful for people who already play. The final section will expand on this by considering leisure more broadly, as well as what makes Bridge a preferable activity over other options.

Leisure is described by Innes et al. (2015) as a key element of a post-modern society, providing freedom from work to engage in pleasurable activities, either individually or with others (Leitner and Leitner, 2012). Recent research suggests differences in trends of individual and group leisure over time, with older adults engaging in more individual activities such as watching TV or going for a walk (Chiu et al., 2013). Unfortunately the rates of participation in activities over time is not consistent across studies (Finkel et al., 2016), therefore it is difficult to draw firm conclusions. More consistently, the type of leisure over time is likely to change, with reduced physical activity, and increased cognitive activity (Finkel et al., 2016). Despite the inconsistencies observed across research, participation in leisure activities has been associated with improved physical, social, and cognitive outcomes across studies (Hutchinson and Nimrod, 2007). For instance, Diamond et al. (2001) in a preliminary study have found that Bridge activates a part of our brains that subsequently increases the number of cd4-positive T lymphocytes (a type of white blood cell), leading to improved immune function i.e. better at fighting infection. Although preliminary, the results highlight how participation in activities that are cognitive and socially stimulating can have surprising benefits.

The studies cited separate activities in cognitive, physical, and social, however, this does not allow for activities which are equally physical/social, cognitive/social etc. Bridge is one such activity that exemplifies this overlap in categories. In an opinion piece by Osberg (2005), Bridge is described as,

> “an elegant game, full of strategy and tactics….but a huge component of Bridge is also very human. This melding of the former with the latter is what sets Bridge apart…”

Similarly, in a recent survey conducted by McDonnell et al. (in progress), participants indicated that Bridge was enjoyable as a result of it being mentally stimulating, competitive, and sociable. As well as the potential immune response benefits (Diamond et al., 2001), leisure activities may reduce the risk of dementia (Verghese et al., 2003), as well as help people to cope with chronic conditions (Hutchinson and Nimrod, 2012).

In their community-based research, Hutchinson and Nimrod (2012) spoke to people with a variety of chronic conditions including arthritis, Parkinson's disease and cancer. They note that there are three ways participation may help people manage: firstly, by serving as a positive distraction and fostering hope (Hutchinson et al., 2010); secondly, by providing opportunities to maintain or improve physical and mental health, which is further supported by decreased health associated with disengagement from activities; thirdly, meaningful activities get support successful aging and well-being (Dupuis, 2008).

Overall, they conclude that,

> "Leisure can be a resource for healthy aging and self-managing their chronic health condition." (Hutchinson and Nimrod, 2012: pp 41).

In Hutchinson and Nimrod's (2012) sample there was at least one Bridge player, who discussed having to give up the activity due to his presumptions about other potential players where he was living. The quote below was said by 'Harvey',

> "How do I say it without sounding like an idiot…It's like playing with children…There are some exceptions. The reason I do not go down on Tuesday to play Bridge is that because some of the people that down there are senile, they do not know…they play Bridge but they cannot [follow the rules]." (Hutchinson and Nimrod, 2012: pp 51).

The quote adds further support to the quote in the previous section from Ms Cummins, where not being able to play at the level expected acts as a barrier. In the quote from Ms Cummins the friend with a memory problem disengaged from the activity, whereas in Harvey's quote, he has disengaged due to concerns that people will be 'senile' and unable to play fully. Whilst this review does not intend to go into detail about language use, the way people with memory problems can be portrayed as 'senile', 'demented' etc. risks fuelling derogatory attitudes, and adds further barriers to leisure for people with and without memory problems.

Concerns over the memory of other players are not necessarily surprising, given the importance of partnerships within Bridge. In the survey conducted by Mcdonnell et al. (in progress), 94% of individuals had regular partners, although encouragingly the mean number of partners was 3. This suggests that if researchers wish to find ways of engaging people with memory problems into Bridge, they could potential rotate partners based on abilities.

Memory itself may not be the only constraint worth acknowledging when considering Bridge interventions. Leisure constraint theory (Carwford and Godbrey, 1987) suggests three principal components to be aware of: Intrapersonal, interpersonal, and structural constraints (Godbrey et al., 2010). The aim of this review is not to critique this theory against other theories of leisure constraint; rather it is used to illustrate alternative obstacles to leisure participation. However of note for research, there is a lot of diversity within leisure activities and context is very important to constraints, which makes measurement challenging (Godbrey et al., 2010).

Intrapersonal constraints to leisure involve individual psychological states which interact with our preferences. Constraints include, stress, perceived skill, peer and family attitude to activity etc. (Crawford and Godbey, 1987, p122). After navigating these constraints, people are sequentially faced with interpersonal barriers such as, whether you have a partner who wishes to engage in the same activity. Finally, people face structural constraints, such as life stage, work-time, access and availability (Crawford and Godbey, 1987).

If Bridge were to be used as an activity for promoting the maintenance of brain health, or minimise deterioration in cognitive conditions, the other constraints to play need to be minimised. An obvious structural constraint is the availability of Bridge clubs, or places to learn to play the game: Numbers of clubs would be needed, as well as whether they clubs were open to beginners. Further, the availability of partners is vital for the success of Bridge. For new players and for players who have learned the game but have since developed memory problems, Bridge clubs would need to provide a welcoming atmosphere that is not purely focused on cognitive skill. Social clubs are therefore more likely to suit than competitive clubs, although early research by Scott (1991) notes that finding a partner can still be a challenge.

A couple of intrapersonal constraints worthy of mentioning are the age demographics, and the difficulty in learning the game itself. An article published in the Telegraph in 2006 suggested that the average age of Bridge players in England is 55, and over 60 years old in America (Caesar, 2006). More recent research carried out by McDonnell et al. (in progress) suggests the average age is even higher, with a mean age of 67 years old. Seeing Bridge as an 'older person's game' may not be detrimental for engaging older adults who wish to maintain or preserve their brain health; however, it may be more off-putting to younger generations looking to start the activity. There is an increasing focus on preventative action towards dementia by exploring factors earlier on in the life course, such as the PREVENT study which is currently recruiting people aged 40-59 year olds (Alzheimer's Society, 2016); based on this shift in focus, it may be that engaging people in Bridge younger could have benefits. This hypothesis is further supported by work presented in the previous section on neuroplasticity.

Although the evidence to support leisure and wellbeing is not concrete, largely due to the large numbers of variables and reliance on correlational evidence, the pattern of results advocates for further research in this area. In particular, research into the benefits of activities such as Bridge which includes a social aspect and sense of being a 'team player' alongside being mentally challenging would be beneficial in the face of an ageing population and motivation to maintain brain health.

An additional concern is how long Bridge takes somebody to learn. Psychological research into the life-course suggests that as people get older or face chronic illness, they will be more engaged in emotionally engaging experiences and less motivated by knowledge-focused goals (Carstensen et al., 1991). This may suggest that people will find Bridge harder to engage with because of the cognitive complexity, and the delayed-gratification from building up a new skill. As an alternative, Maureen Hiron developed 'ABridged' , a simplified version of the complicated game, allowing people to pick up the necessary skills more quickly (Caesar, 2006). However, the evidence and discussion thus far is based on online reviews and newspaper discussion pieces. It is not clear whether alterations to the game are what is needed, or whether there are different constraints which need challenging.

Current work in Bridge

To finish, the work of Malysa (2016) and colleagues on the Bridge 60+ programme is worth noting. The programme is aimed at encouraging older adults into Bridge, as a way of reducing risk of Alzheimer's disease and other dementias (Malysa, 2016). Although, as this review has demonstrated, the causal links between cognitive training and dementia risk are not clear cut, the evidence collected suggests it is worth exploring in greater detail. The Bridge 60+ programme draws on knowledge of adult learning theory to consider how best to engage older adults in learning to play Bridge (Blajet, 2016). Importantly, Blajet (2016) discusses how adult learning includes a need to be challenged as well as have success, as we have evolved to thrive by pushing our capabilities. As such, it is important that we do not assume people with memory problems will struggle with learning Bridge, and therefore should not do it. Rather, it is important to find a way of balancing out some of the challenges while allowing for success. Another key strength of the programme is the opportunity to engage younger and older people in bridge, increasing intergenerational communication and potentially breaking down some of the stigma surrounding age and memory problems.

Recommendations and conclusions

Throughout the review there have been difficulties in drawing strong conclusions from the evidence relating to cognitive activity and brain health. There are several key reasons for this including, the large number of variables impacting on people's experiences which makes it difficult to reduce down to a cause and effect relationship (Fratiglioni et al. 2004); inconsistency of terms (e.g. leisure activity) which makes it problematic to compare studies and suggests a need for a more standardised approach (Scott et al., 1991); and the complexity of the brain meaning there continues to be a lot of unknowns which need isolating to make conclusions.

Overall, the literature review provides an overview of memory and memory-based disorders, with a focus on cognitive activity and whether it can lead to 'healthy ageing'. The research on neuroplasticity and cognitive reserve suggests a very promising area of future research, both in the neurological field and psychosocial domains, by highlighting how different interventions could add to cognitive reserve. The discussion around meaningful activity highlights that people have positive outcomes when taking part in activities that are important to them, or are part of their self-identity. The difficulty is in how people who have memory-focused activities as part of their identity deal with changes. It is unclear from the research available whether people with dementia are able to learn or play Bridge, but the potential for it to be a cognitively stimulating and social interactive activity suggest its worth considering in more detail.

The quotes presented from anecdotal evidence support concerns that people with memory problems, whether age-related or dementia, may withdraw from activities such as Bridge. This is likely to result in experiences of loss and lower self-esteem (Gillies and Johnston, 2004). In terms of competition adjustments, it may be that an open tournament for all abilities is an option but those who have previously done very well may feel distressed by the change. Alternatively, events specifically for people with memory concerns may suit some people, although many people choice not to identify themselves as having a memory problem or dementia (Garand et al., 2009). Bridge is dependent on working well with your partner; as a result people may 'drop out' through fear of burdening one particular person. A set-up that allows for continual changing of partners and mixes of abilities may allow people to stay involved in Bridge without the focus being on cognitive ability or continually 'holding another person back'.

Another option may be to encourage people with memory problems to celebrate what they know about the game by teaching novices how to get involved. This has several possible advantages; firstly, it keeps people engaged with an activity they enjoy; secondly, it encourages social interaction and boosting self-esteem through knowledge transfer; thirdly, it may help to reduce stigma (negative attitudes and beliefs attached to dementia and memory problems) through increased contact (Corrigan et al., 2012). Similar approaches to reduce stigma have been used with choirs for example, where people with and without dementia perform together (Harris and Caporella, 2014).

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