Title: Diglossia in the aetiology of schizophrenia: a hypothesis.
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Abstract

A hypothesis offering diglossia as a potential risk factor for schizophrenia is presented. This is supported primarily by an account of the numerous co-occurrences between the diglossic phenomenon and the established risk factors and features of schizophrenia, such as language impairment, working memory dysfunction, social adversity, urbanicity, migration and ethnicity, as well as some of the broader educational elements including illiteracy, reading deficits and poor academic attainment. With an emphasis on the inherent role of language in schizophrenia and the demand for elucidating a mechanism behind its risk factors, we propose that a diglossic environment in childhood may constitute a neurodevelopmental insult predisposing to the development of the disorder. This relationship may be mediated by the reduced lateralization of language in the brain which has been observed in relation to schizophrenia.

Key Words: Language, Education, Urbanicity, Migration, Psychosis

Introduction

Language is paramount to schizophrenia, contributing to a myriad of aetiological, diagnostic and therapeutic tools central to our understanding of the disease. Language changes are often described in patients, most famously by Kraepelin and Bleuler, and were seen as evidence of either "thought disorder" or "speech disorder" respectively (Morice and McNicol, 1986). Childhood language abnormalities are identified in 19-55% of individuals with adult and early-onset schizophrenia

(Vourdas et al., 2003), indicating that early language acquisition may be a factor in the disease process. Moreover, the premorbid impairments contributing to the neurodevelopmental hypothesis of the disease are mostly observed in the domain of language and speech (Nicolson et al., 2000; Vourdas et al., 2003). As such, it is hypothesized that linguistic disorganization in schizophrenia plays a fundamental part in its pathogenesis, and that the origins of thought and selfhood disturbance that characterise the disease are at least partially mediated by language (Hinzen and Rosselló, 2015). This description may relate from a pathological perspective to the substantial debate on the influence of language on thought and perception. The Whorfian hypothesis (Whorf, 1956) proposed that the features of language exert an influence on individual thoughts and cognitive processes (Fishman, 2007), and later evidence has shown that language guides thought (Ervin-Tripp, 1967), affects perceptions of time (Boroditsky, 2001), and interferes with memory (Klemfuss et al., 2012; Loftus and Palmer, 1974). Though not widely recognized, the language model of psychotic phenomena presents the main positive symptoms as “failures in language-mediated forms of meaning” (Hinzen and Rosselló, 2015). Auditory hallucinations are seen as a malfunction of language perception, thought disorders are considered the result of disordered language production, while delusions can be seen as a manifestation of abnormal linguistic content (Hinzen and Rosselló, 2015; Howes et al., 2004). We add that language may also play a role in the visual disturbances reported in up to 62% of patients (Phillipson and Harris, 1985), given evidence which shows differences in colour perception between different language speakers (Gilbert et al., 2006), as well as language-dependent deficits in contrast perception (Maier and Abdel Rahman, 2018) and motion processing (Meteyard et al., 2007), which are both shown to be impaired in schizophrenia (Chen et al., 1999; Slaghuis, 1998). Therefore, individuals predisposed to these symptoms predictably face difficulties in acquiring and understanding language in their early years (Howes et al., 2004).

A number of intrinsic language-related aetiological abnormalities have been suggested for the neurodevelopmental basis of the disease, including dyslexia (Horrobin et al., 1995; Whitford et al., 2018), auditory processing disorders (Javitt and Sweet, 2015), poor social development (Glatt et al., 2006), impaired receptive language and lower intelligence (Cannon et al., 2002). However, the role of the potentially malleable extrinsic language environment which may be in direct association with the already identified environmental risk factors, has not received attention in the literature. In particular, the role of the linguistic phenomenon known as diglossia, which is widely observed in various speech communities, has not been described or investigated. As the knowledge base behind the social and environmental origins of schizophrenia accumulates, the aetiological mechanisms behind them remain elusive. By providing an account of the overlap between diglossia and the identified risk factors such as language impairment, social adversity, urbanicity, migration and ethnicity, we shed new light on some of the observations surrounding the disease. Thus, with a view of language in an explanatory framework, diglossia is identified as a potential independent factor in the development of schizophrenia, and a contributor to social adversity and the neurodevelopmental hypothesis of the disease through the impact it has on developing children and adolescents. Furthermore, we present a neuroanatomical basis for the correlation between diglossia and schizophrenia using evidence from neuroimaging studies.

The phenomenon of diglossia

The term “diglossia” was initially used by Charles Ferguson (1959) to refer to a situation in society where two varieties of the same language are interchanged depending on the setting. This is exemplified most typically in Arabic by a classical “high” (H) form of the language employed in formal communication, and a colloquial “low” (L) form for everyday familiar practice (Ferguson, 1959). Ferguson further qualifies that for there to be a diglossic relationship between two language varieties, striking differences must exist in grammar, lexicon, phonology and other language domains

such that ultimately no segment of the community uses the formal form as a medium for ordinary conversation. This situation typically arises for the first time at the beginning of the school journey, where a child is faced with the mismatch between the familiar spoken language at home and the formal language used for learning. This phenomenon is traditionally and formally observed in Arabic speaking countries, as well as in Modern Greek, Swiss German, and Haitian Creole amongst others. However, as argued by Pauwels (1986) with the advent of globalization, “societal changes such as modernization, urbanization, and the breakdown of rigid class barriers” have led to a more dynamic, functional understanding of diglossia (Pauwels, 1986). The concept was expanded by Fishman (1967) to include various distributions of the high-low dichotomy in which the language varieties serve different communicative purposes and have different social prestige (Fishman, 1967; Tollefson, 1983). He pointed out that this can involve more than two varieties or even an entirely different language. For example, a Western language (usually French or English) may become a widely used variety for certain matters (usually science and technology), while the native language serves other “low” functions. Furthermore, he describes how the social role taken by the individual can determine the language variety that must be used to comply with the recognized social consensus (Tollefson, 1983). Finally, Auer (2005) presents a model for diglossia which captures the relatively new context of national standards against the various dialects in most of Europe, acting as H and L forms respectively. He argues that there are significant detectable differences in the language used at home and the national standard used in education and government (Auer, 2005). Thus, the definition of diglossia has become more broadly defined as the association of compartmentalized language varieties with compartmentalized social roles and situations, typically imposed at the socio-cultural level (Tollefson, 1983). In practice, the H language is perceived as more prestigious, more attractive, and exclusively worthy for education, literature, religion and other H functions. The other “informal” Language (L) is generally looked upon unfavourably, despite being the “mother-tongue” of the community (Fishman and García, 2010). What is pertinent is that the forms of language are usually

not of equal status. Hence, the major feature of diglossia is the hierarchy of language imposed on the individual, and especially for the purpose of this paper, the developing child. Almost invariably in a diglossic environment, the mother tongue has the lower status, presenting an obstacle not faced by children in a non-diglossic setting, where the mother tongue is used in all aspect of life, from education to future employment (Brri et al., 2010).

While recognizing multiple confounders such as income and availability of psychiatric services, diglossia is formally recognised in numerous countries worldwide, and features prominently not only in North Africa and the Middle East but also in East and South Asia, regions where schizophrenia has some of the highest prevalence measures reported and the biggest impact according to disability adjusted life year (DALY) rates (Charlson et al., 2018). Nevertheless, the compartmentalization of language is not always as well-defined as in Arabic countries for example. Blom and Gumperz (1972) have demonstrated that language switching can be a subtle and overriding process (Ervin-Tripp, 1967). Among a Norwegian diglossic cohort for example, an unconscious increase in the use of standard lexicon was observed when general topics are introduced instead of local issues between neighbours (Blom and Gumperz, 1972; Nilep, 2006). Furthermore, at a higher resolution the hierarchy of language forms present in diglossia is not geographically restricted and is indiscriminate in the form of sociolinguistic prestige and varying discourse (Gee, 2008). An individual's perception of his or her own dialect pitted against a more prestigious dialect or language, may form the basis for a universal explanation even in settings where diglossia is not formally recognised. This individual experience may be a useful and disentangled measure for the effect of diglossia.

Diglossia and language development

Diglossia exerts a negative impact on children's development of specific language skills such as the phonological awareness, pseudo word decoding, and word reading. This effect is also found to be

persistent during the early schooling years (Schiff and Saiegh-Haddad, 2018). In parallel, several studies have reported schizophrenia-related reading deficits (Whitford et al., 2018), including those implicated in diglossia, such as impaired phonological awareness (Revheim et al., 2006). Similarly, diglossia and schizophrenia have both been separately associated with the reduced ability in performing word and nonword repetition tasks (Farnam et al., 2015; Saiegh-Haddad and Ghawi-Dakwar, 2017), implying a common deficit in verbal working memory. A working memory dysfunction is proposed to be a fundamental impairment leading to thought disorder in schizophrenia (Deserno et al., 2012; Goldman-Rakic, 1994).

From a wider educational perspective, literacy rates in Arabic countries are much lower than expected relative to their wealth, and it has been suggested that this is due to the diglossic situation (Myhill, 2014). Diglossia is also negatively associated in overall successful language acquisition and reading ability, as the specific deficits mentioned previously have cascading consequences on the development of reading skills and reading fluency (Schiff and Saiegh-Haddad, 2018). Simply put, diglossia is at least partly responsible for reading deficits observed in children entering school in a diglossic context. This, combined with evidence that patients with schizophrenia show severe deficits in reading ability (Revheim et al., 2014), is further indication that diglossia may contribute to dysfunction of language which has been hypothesized to be involved in the pathogenesis of schizophrenia. The outcomes of diglossia, namely illiteracy, poor academic attainment and school drop-out (Ayari, 1996) have separately been correlated with a higher risk of schizophrenia in the literature (Dickson et al., 2018; Goulding et al., 2010; Liu et al., 2013), but not together under the umbrella of diglossia. Supposing that the two instances of language difficulty are not inherently related, diglossia may be seen to at least contribute to the social adversity which increases the risk of developing schizophrenia (Wicks et al., 2005), given that children's language skills and literacy are predictors of future social and academic outcomes (Pace et al., 2018),

Diglossia and urbanicity

Urban environments are associated with a risk of schizophrenia 2.37 times higher than that in the most rural areas, and underlying approximately 30% of the overall incidence (Krabbendam and van Os, 2005; Vassos et al., 2012). Yet, this association is merely a proxy for an undefined environmental exposure which seems to operate on a number of premises, as suggested by the research into its nature (Krabbendam and van Os, 2005). First of all, the type and variation of geographical distribution suggests continuous or repeated exposure, as demonstrated by an increasing risk of schizophrenia with higher degrees of urbanization and longer durations of urban habitancy (Pedersen and Mortensen, 2001). Furthermore, the impact of this exposure predates the onset of the illness in adulthood, taking place during childhood or early adolescence instead (Marcelis et al., 1999). The magnitude of this factor appears to increase with time and becomes stronger with subsequent generations, with a more significant effect seen in more recent birth cohorts (Marcelis et al., 1998). Finally, the various potentially responsible exposures occurring with urbanicity such as infectious disease or socioeconomic status have largely failed in either satisfying these premises or producing the required statistical relationships (Harrison et al., 2003). An extensive range of confounders such as high rates of drug use and ethnicity in urban areas have been controlled for in the studies (van Os et al., 2010). This leaves an empty mould for a yet unknown environmental factor exerted by urbanicity, that which diglossia appears to fit adequately. Consistent with the premises above and as argued previously, diglossia is 1) first encountered during childhood 2) a form of continuous exposure throughout schooling years 3) Increases with time and subsequent generations 4) contributes to poor social outcomes.

The evidence for a rural-urban contrast with diglossia that may facilitate the potential relationship can be derived from various accounts of changing language in urban areas. Several clues are gained by examining the instances of prominent language phenomena in urban environments from a practical perspective. The relatively high incidence of schizophrenia amongst African Americans (Schwartz and Blankenship, 2014) can be used as a tangible example to suggest diglossia as a potential driving force that mediates development of schizophrenia in urban settings. This is enabled by looking at how the prominent use of African American Vernacular English (AAVE) amongst the cohort operates. AAVE is a widely spoken form of English amongst African-Americans particularly in urban communities (Schneider and Kortmann, 2004). It is characterised by multiple differences from the competing “standard” English across multiple linguistic domains. This context is a form of diglossia, in which each dialect may be employed in different situations (Linnes, 1998). In the case of African-Americans in the United States, Standard English represents the H variety which is desired for education, jobs, and communication with non-speakers, while the mother tongue, AAVE is the L dialect for everyday use within the community (Ogbu, 1999). AAVE use is associated with adverse educational, housing, income, and employment outcomes (Rickford et al., 2015). Furthermore, AAVE is more frequently adopted by men (Rickford, 2010). These features and effects of the diglossic AAVE correlate with some of the risk factors for schizophrenia, namely the higher risk among African Americans, the male preponderance, urbanicity, unemployment, the low educational and socioeconomic status. While studies have accounted for ethnicity in the relationship between urbanicity and schizophrenia (Krabbendam and van Os, 2005), it is important to highlight that while AAVE is typically associated with African-Americans, it is not exclusive to this cohort as shown by AAVE adoption amongst Asian-Americans in urban settings (Reyes, 2005). Hence, diglossia in this case is a feature of urbanicity as opposed to ethnicity, and it remains unaccounted for.

Diglossia and migration

The case of Multicultural London English (MLE) is another example of a non-standard variety resembling AAVE (Rickford et al., 2015), which is widely spoken in parts of urban London particularly amongst the Pakistani and Afro-Caribbean communities (Torgersen and Hansen, 2012), who are also amongst the highest-risk ethnic groups in London with up to 4 and 10 times higher rates respectively (Kirkbride et al., 2017). MLE presents another example of the potential relationship between diglossia, urbanicity and schizophrenia with the same mentioned parallels, but also ties in the influence of migration, another established risk factor for the development of schizophrenia (Cantor-Graae and Selten, 2005). Cheshire et al. (2011) have highlighted the dynamic forces driving language change in urban settings, specifically pointing to the rise of MLE. They refer to the creation of multicultural yet locally isolated urban arrangements characterizing major cities. This is facilitated by the migration of people from varying backgrounds who frequently move into secluded and socioeconomically deprived areas, leading to the maintenance of close family and neighbourhood ties (Cheshire et al., 2011). Within these segregated areas, children firstly acquire the language of the caregiver. Subsequently, language change occurs through the imperfect acquisition of the majority language from other second language speakers of diverse backgrounds, due to the unavailability of native models of language in those areas. Under certain conditions, such as the interaction with other children in school, these language forms may then be absorbed by native speakers. For example, on the effect of Afro-Caribbean immigration on English in London, it is observed that words of creole origin were employed by native children between themselves. This eventually leads to the progress of MLE amongst the urban population regardless of ethnicity (Cheshire et al., 2011). This phenomenon is not restricted to the United Kingdom, as the novel and distinctive forms of the home languages in multilingual, working-class areas in various European cities are captured as “multiethnolects” (Cheshire et al., 2015). Interestingly, the research into MLE use shows a marked peak in adolescence

for the various differences in language domains (Cheshire et al., 2011). This coincides with the age at which schizophrenia typically starts to arise in the population.

The effect of migration and multilingualism on societal language patterns could be seen as an environmental exposure presented by urbanicity. As such, it can be argued that migration creates two incidents of diglossia. Firstly, the mother tongue of the migrant naturally occupies a lower status than the host language of the new country. This creates an exposure pertaining to the migrant individual. Secondly, mass migration has the means to change the native language as described previously, creating a wider exposure relating to the urban context. Should the first type of exposure correlate with the incidence of schizophrenia, it may be the case that migrants with the same first-language as the host country would have lower rates of schizophrenia compared to those with whom there is a mismatch. While frequently proposed as a contributor to the social adversity faced by migrants (Ampadu, 2011), there is no research on the impact of the exact mother tongue variety on rates of schizophrenia amongst migrants. For example, does a migrant from the English-speaking and the Spanish-speaking Caribbean have the same risk of developing schizophrenia? The second type of diglossic exposure presented by migration may be supported by the increased risk in urban settings and the fact that the higher risk amongst migrants increases with subsequent generations (Harrison et al., 1997). The highlighted risk for migrants persisting into the second generation can be argued to be reflective of this lasting and progressive language change which remains at contrast with the preserved H language form of education and social prestige, as well as the situational switching of language which may be required to communicate with the caregivers, i.e. the first-generation migrants.

The neuroanatomical relationship between diglossia and schizophrenia

A neuroanatomical basis for a relationship between diglossia and schizophrenia can be derived from recent findings utilising functional magnetic resonance imaging (fMRI). One of the hallmarks of schizophrenia is an aberration of language lateralisation. This is supported by structural evidence in post-mortem studies (Crow et al., 1989; Cullen et al., 2006), and functional evidence using evoked potentials (Spironelli et al., 2008) and fMRI studies, with results indicating that language processing is less lateralised in patients than in controls (Sommer et al., 2001; Weiss et al., 2006). i.e. language processing does not exhibit the same degree of left-lateralisation normally seen in healthy individuals (Frost et al., 1999). While the anatomical research into diglossia is limited, an fMRI study conducted by (Nevat et al., 2014) in an Arabic diglossic context has found that activation during linguistic tasks for spoken Arabic (L) is less lateralised than literary Arabic (H) (Nevat et al., 2014). A recent fMRI study of dialect comprehension in a German diglossic context has not reported a laterality index for the language forms (Schmitt et al., 2018). However, the contrast of the High Alemannic Dialect versus Standard German revealed significant activations primarily outside the extended language network. The High Alemannic dialect showed differences of stronger activation in various right sided areas as well as left: in the right superior temporal gyrus, the right anterior middle frontal gyrus, the right and left premotor area/supplementary motor area, the left Heschl's gyrus, and the cerebellum. This may be indicative of reduced left-lateralisation. By the same account, an fMRI study on schizophrenia patients showed that language processing is less lateralised than controls with stronger activation in the right hemisphere (Sommer et al., 2001). The authors propose that the reduced lateralisation of language in schizophrenia may result from failure to inhibit the right hemisphere (Sommer et al., 2001), which may be a feature in the non-standard dialect processing. Interestingly, the results of the fMRI study into German dialects also showed stronger language-related activation in the High Alemannic dialect with greater degrees of perceived pleasantness (Schmitt et al., 2018),

potentially implicating a role for dopamine, previously correlated with subjective ratings of pleasantness (Egerton et al., 2009; Salimpoor et al., 2011; Small et al., 2003) in the individual awareness of a dialect against a higher language form.

An insight into how this neuroanatomical basis may manifest clinically can be gained by looking into a study by Hemphill (1971) in the context of a unique linguistic situation in South Africa (Hemphill, 1971). Briefly, the non-prestigious, spoken-only Afrikaans has traditionally represented a typical L language form, used mainly at home and amongst the community. Whereas H functions such as literary, official and religious interaction were fulfilled by Dutch or English depending on the situation (Krishnamurti et al., 1986). While Afrikaans was subsequently promoted as a co-official language with English, the traditions of diglossia appear to be deeply rooted as English remains to be associated with more power and prestige (Silva, 1996). Nevertheless, the H-L relationship between Afrikaans and English and even other languages such as Xhosa is sometimes interchangeable between communities, as highlighted by different preferences for either language as a status or political symbol (Dyers, 1997). The study by Hemphill (1971) reports the cases of 30 bilingual schizophrenia patients who displayed psychotic phenomena only in their mother-tongue (L), whilst functioning normally in environments which demanded another language (Hemphill, 1971). Interestingly, despite English being a traditional H, when the situations are reversed as in the case of a man who worked in an Afrikaans office and preached in Afrikaans, which are typically H functions, the psychotic phenomenon are exhibited in English, thereby acting as the L form. Therefore, a retrospective remark on this study is that the propensity for these patients to exhibit symptoms of schizophrenia in the L language may be a manifestation of decreased lateralisation of that particular language form, due to the diglossic context in which it arose.

More recently, a series of bilingual interviews reported by Zulueta et al. (2001) (Zulueta et al., 2001) can give further insight into how diglossia can operate as a neurodevelopmental insult. They describe two cases of bilingual patients in which a diagnosis of schizophrenia was made. Both patients saw their mother-tongues situationally superseded by a second language at the young ages of 8 and 11 for the purpose of education, an H function. These patients exhibited the majority of their psychotic phenomena in their mother-tongue, a conceivable L form in a diglossic context, while showing little to no symptoms in their H language. Another case was presented for a patient who was introduced to a second language in her early 20's. Contrastingly, there were no major differences in her mental state between the two languages. This contrast could be attributed to the age at which the potential H-L dichotomy presented, which is perhaps too late for diglossia to have a neurodevelopmental effect. A fourth case presented a patient whose history of language acquisition makes it difficult to determine the primary language, and as a result it is unclear if differences between the languages could be significant for the purpose of this argument. Hence, we argue that diglossia may result in a neurodevelopmental insult during childhood or adolescence, causing the mother-tongue (L) to become less lateralised in the brain, and consequently leading to a propensity for psychotic phenomenon in that particular language form. This is in line with the neurodevelopmental model of schizophrenia, which stipulates that a pathological process takes place before the brain nears its adult anatomical form during adolescence (Fatemi and Folsom, 2009; Murray and Lewis, 1987; Rapoport et al., 2005).

Challenges and future considerations

While efforts have been made towards realising a unifying mechanism behind the social and environmental risk factors of schizophrenia, as proposed by the social defeat hypothesis for example (Selten et al., 2016, 2013; Selten and Cantor-Graae, 2005), the contribution of language which is itself

a determinant of social interaction (Brinton and Fujiki, 1993) has been overlooked. Diglossia can be a viable explanation mediating several of the risk factors for the development of the disease, and it may represent a potentially independent risk factor. It also has the advantages of being a malleable environmental exposure and bypassing issues of reverse causality, since it is typically imposed on entire populations at the sociocultural level. Importantly, the feasible role of diglossia is not an alternative but an addition in the quest to integrate the knowledge of the different factors into an encompassing psychosocial framework for schizophrenia. Suggestions for further research include studies to establish an epidemiological link, as well as research into the neuroanatomical relationship using imaging studies. Neurophysiological studies involving event-related potential and specifically Mismatch Negativity may also hold value considering its documented relationship with schizophrenia (Erickson et al., 2016) as well as its common use in language studies as a correlate of language-specific phonological representations (Khamis-Dakwar and Froud, 2014), which may help in drawing parallels between diglossia and schizophrenia.

However, the challenge lies in acquiring the epidemiological data to support a correlation. This is firstly due to difficulties in quantifying the scope of diglossia. Secondly, there is inadequate epidemiological data around the world concerning the two entities. In Arab countries where diglossia is universal, there is an unsatisfied requirement for national studies on schizophrenia (Saab et al., 2011). An obvious prediction is that higher rates of schizophrenia will be observed in populations where diglossia is dominant. Discussions of unifying the national language in the face of diglossia are highly controversial historically with the Greek language question as an example (Mackridge, 2009), and questions are presently raised in other diglossic countries such as Egypt with regards to standardising the L variety (Yacoub, 2015). Thus, the implications of this potential relationship will serve ongoing debates to address diglossia in public and educational policy.

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