Bilingual advantages in middle-aged and elderly populations
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Chapter 7

General discussion

7.1. Introduction.

In this dissertation, we have reported on the results of a study that looked at possible associations between bilingualism and cognitive performance and included chapters that were independently submitted to peer reviewed journals. First, we investigated in how far bilingualism may affect general cognitive functioning, in particular the efficiency of executive functions that may play a part in language processing. Second, we investigated whether any potential effects of bilingualism found for early balanced bilinguals extend to bilinguals who acquired proficiency in a second language at a later age. Third, we looked at possible effects of bilingualism on linguistic performance. Because of possible interactions between bilingualism and aging in these effects, our study focused on the performance of middle-aged and elderly individuals. Last, we analyzed interactions between the results of the verbal and nonverbal tasks of our study.

In this concluding chapter, we will try to put the different strands of this study together and reflect on our main findings. The structure of this chapter is as follows. In the background section, we explain why we started this project, and briefly summarize the relevant studies conducted previously in this field. Then we repeat the research questions that we defined in the introductory chapter and show for each question how it contributes to the research field. We will answer these research questions one by one. Next, we will interpret these findings and put them in a wider perspective. In the last part of this chapter, we will indicate the limitations of our project and give some recommendations for future research.
7.2. Background.

As we described in the introductory chapter, around the turn of the century the first evidence was published showing an advantage for bilinguals over monolinguals in performance on a number of cognitive tasks, in particular with children (c.f. Bialystok & Martin, 2004) and middle-aged and elderly adults (Bialystok et al., 2004). The explanation proposed was that bilinguals’ practice in managing multiple languages might enhance the efficiency of aspects of executive control involved in linguistic processing. Apparently, the experience in a number of skills in a linguistic domain, such as inhibiting the non-target language, had transferred to an advantage in more general cognitive functioning. However, when more studies were conducted in this field, the results were contradictory. Especially, as shown in review articles by Costa et al. (2009), Hilchey and Klein (2011) and Paap, Johnson and Sawi (2014), evidence for an advantage for bilinguals in conflict resolution appeared to be rare, although not entirely absent (c.f. Yang, Yang & Lust, 2011; Poarch & Van Hell, 2012). For tests investigating other aspects of executive functioning, the results were not conclusive either: some studies for instance reported advantages for bilinguals in task switching paradigms (e.g. Prior & MacWhinney, 2010), but other studies did not find such differences (e.g. Paap & Greenberg, 2013).

The explanations for these contradictory results concern in the first place the lack of agreement on what the different executive control tasks are measuring; according to Valian, they ‘measure multiple processes simultaneously, including processes that are not part of executive function, like response readiness’ (2015, p. 4). The second explanation is that task results can be confounded by a huge amount of other factors. These factors may be extra-linguistic, since a range of other experiences may affect executive control efficiency, but
can also concern language status and background. The number of languages that are spoken, the age of acquisition of the second language and the degree of cognateness of the two languages are all examples of language-related factors possibly affecting task-results.

In the introductory chapter, we also argued that most studies seem to agree that on linguistic tasks bilinguals are usually outperformed by monolinguals. Bilingual adults do not always have smaller vocabularies (Fernandes, Craik, Bialystok & Kreuger, 2007), but are often slower in lexical access (Ivanova & Costa, 2008). Moreover, they show more tip-of-the-tongue problems (cf. Gollan & Acenas, 2004), a difference that increases with age. The main issue about the differences that are often found between monolinguals and bilinguals in verbal production tasks is that it is not always clear what causes them. Several explanations have been proposed, which need not mutually exclude each other. First, especially unbalanced bilinguals may have smaller vocabularies than bilinguals, which can lead to lower task scores (c.f. Gollan & Acenas, 2004; Sandoval et al., 2010). The second explanation (the ‘weaker links account’) takes an emergent perspective by proposing that lexical items are less easily accessible to bilinguals than to monolinguals because they are less often used, and thus less often activated. The third explanation (the ‘interference account’) attributes delays in bilingual lexical retrieval to interference effects of the non-target language: bilinguals are slower because they have to cope with lexical competition.

Finally, Bialystok, Craik and Luk (2008) and Bialystok (2009) suggested that the conflict between a bilingual’s competing language systems may be at the bottom of the bilingual disadvantage in lexical access, and the enhancement that was sometimes reported for executive control function. Between-language interference is hypothesized as the
common ‘mechanism’ explaining both bilingual disadvantages in verbal performance, and bilingual advantages in general cognitive performance.

7.3. Research questions, answers and contributions to the research field.

The first research question in the current dissertation was whether a group of early bilinguals differs from a group of monolingual controls in general, nonverbal cognitive performance. Secondly, we investigated whether in this respect there was an interaction between bilingualism and aging. What our study aims to contribute to the research field is, first, that we have compared performance of groups of middle-aged and elderly adults. Relatively few experimental studies have been conducted with these age-groups, especially studies using a task-switching paradigm. Focusing on these two age-groups makes it possible to analyze whether bilingualism can be associated with a modulation in an age-related decline of executive control. Another strength of the design of our study is that our bilingual group was relatively homogeneous, in that all participants were bilingual in the same language pair, and that they all acquired both languages in a natural setting before the age of 6, because of being born in a bilingual region. Their languages were typologically closely related, and also closely related to the language spoken by the monolingual group. Thus, by controlling for these linguistic factors, we have tried to minimize the variables that could confound the task results in our study.

As we have described in chapter 3, our results show that the group of early bilingual Frisians differs from the monolingual Germans in general cognitive performance, in that they incurred significantly smaller switch effects. This difference was most pronounced in elderly participants, which is reflected in a significant interaction between the factors
bilingualism and aging in the size of the switching costs. In our study, bilingualism can thus be associated with a modulation of an age-related decline in the efficiency of executive control.

The second research question of this project was whether any differences in general cognitive performance that we might find between early bilinguals and monolingual controls would extend to groups of late bilinguals. Previously, studies that focused on performance by bilinguals who acquired their L2 after puberty (Tao et al., 2011; Luk et al., 2011) concerned groups of young adults. Looking at the performance of middle-aged and elderly participants would enable us to disentangle possible effects of the factors age of onset and duration of bilingualism. Additionally, the inclusion of an older age-group enables an analysis of interactions between bilingualism and aging. Finally, the late bilinguals that we tested are fluent in the languages spoken by the early bilinguals and the monolingual controls, namely German and Dutch.

As we have shown in chapter 4, the late bilinguals differed from the monolingual controls in that, just like the early bilinguals, they incurred significantly lower switch costs and that this difference was most pronounced in elderly participants. The groups of early and late bilinguals did not differ in any of the measures that we looked at. Data of the group of late bilinguals did not show any correlations between measures of executive control and factors reflecting language background, such as age of onset or duration of bilingualism. These findings confirm the association between bilingualism and efficiency of executive control, in particular switching between mental sets, that we found for early bilinguals, and suggest that at least for our group of speakers there is no effect for age of onset or duration of bilingualism.
The third research question of this study was whether there were any differences between early bilinguals and a group of monolingual controls in linguistic performance, as manifested in performance on a verbal fluency task. The main contribution of this study to the research field is that we have not only looked at the total number of words that are produced in this test, but also at measures of clustering and switching, which may give an insight into the processes going on during lexical production. To our knowledge, this is the first study that uses this method to investigate what happens to lexical access in bilingual aging. Another contribution of this study to the research field concerning this research question is that it includes bilinguals who are highly fluent in two languages that are typologically strongly related; not only do Dutch and Frisian have many cognates, but many lexical items are exactly the same in these two languages. Our study thus has its own specific characteristics and dynamics and complements other research that looks at speakers of languages that are typologically further apart.

As we have shown in chapter 5, our study found a difference between the two language groups, but did not find a disadvantage for the bilingual group on any of the task components. In semantic fluency, bilinguals and monolinguals produced the same numbers of words, with a similar age-related decline for both language-groups. On phonological fluency, the middle-aged groups performed similarly, but there was an age-related decline only for the monolinguals, and not for the bilinguals.

Our last research question concerned the hypothesis that the same mechanism, i.e. language interference, might explain both bilingual disadvantages in verbal performance and an advantage in general cognitive performance. The fact that in our study the same participants conducted both a verbal and a nonverbal task enabled us to investigate possible
interactions between verbal and nonverbal functioning in bilinguals, by looking at
correlations between the results on these tasks. Within the group of early bilinguals, we
found significant correlations between the size of the switch and the mix effect on the one
hand, and scores on semantic fluency and category switching on the other hand. We also
found that these correlations were mediated by working memory.

7.4. The context and relevance of our study on executive control in a broader sense.

7.4.1. Transfer of language skills to general cognitive functioning: patterns of age-
related decline.

The main issue at the heart of the research on effects of bilingualism on cognitive
functioning is whether and to what extent linguistic skills can transfer to more general
cognitive functioning. This relates to the central question whether bilinguals depend on
domain-general executive control mechanisms to achieve language control, or whether their
language control is managed by a separate mechanism, dedicated specifically to that
purpose (c.f. Gollan, Sandoval & Salmon, 2011; Costa, Miozzo & Caramazza, 1999).
Weisberger, Wierenga, Bondi and Gollan (2012) addressed this question in an experiment
involving a cued language switching and a cued (non-linguistic) task-switching test, and
Gollan, Sandoval and Salmon (2011) in an experiment involving a verbal fluency test and a
flanker task. What the studies have in common is that they focused at the performance of
elderly bilinguals, to see whether patterns of age-related decline were similar in linguistic
and non-linguistic tasks. Both studies concluded that mechanisms of non-linguistic task
control and language control are partially shared: for instance, language-intrusion rates
correlated with flanker task error rates in the elderly group, but were still so rare, that the
authors suggest that besides executive control a language-specific control mechanism might prevent the occurrence of language intrusion.

7.4.2. Transfer of domain-general language skills to general cognitive functioning:

*switch cost symmetry.*

A few other studies approached the relationship between domain-general, non-linguistic executive control and language control by looking at the symmetry of switch costs in both linguistic and non-linguistic switching tasks. For instance, Calabria, Hernández, Branzi and Costa (2012) reported on a study involving a group of highly proficient, balanced Catalan-Spanish bilinguals performing a linguistic and a non-linguistic switching task. The idea behind this experiment was that highly proficient bilinguals have comparable switch costs when switching between L1 and L2 and between L2 and L1. Indeed, the participants overall showed symmetrical switch costs in the linguistic switching task, but not in the non-linguistic switching task, from which the authors conclude that bilingual language control is not entirely subsidiary to a domain-general executive control system.

7.4.3. Validity of the use of task-switching tests in the context of bilingual research.

Another point that has been raised in this context of the relation between domain-general and language control (Gollan & Ferreira, 2009; Gollan, Kleinman & Wierenga, 2014) is to what extent the switching that is done in experimental designs, for instance cued task-switching paradigms, is similar to the natural phenomenon of switching languages, because in natural, ‘real-life’ settings a switch to another language usually reflects the intention of the speaker. Still, Gollan and Ferreira (2009) report switch costs even in experiments
involving voluntary switching, from which they conclude that bilinguals switch languages, in spite of incurring switch costs, because using words from either language enables them to label more concepts (661). Moreover, in a study in which they compare voluntary and cued switching, both in linguistic and non-linguistic tasks, they also report robust switch costs for all types of switching, a finding which ‘argues against the notion of language control as a special case in which switches are necessarily cost-free’ (Gollan, Kleinman & Wierenga, 2014, p. 20). Nevertheless, they also report some cost-free switches both in linguistic and non-linguistic tasks, under limited conditions. It can therefore be questioned in how far switching between languages in real life can always be seen as a voluntary process, reflecting the speaker’s intention, because language switches tend to be at least partially primed by environmental cues, such as the sudden appearance of another person who does not speak the language formally engaged upon, or the introduction of a subject that is usually discussed in the second language (see also Bialystok, Craik & Luk, 2012; Peeters, Runnqvist, Bertrand & Grainger, 2013).

7.4.4. Evidence for transfer of linguistic skills to general cognitive functioning from performance on executive control tasks.

If all, or at least the vast majority of, the studies comparing monolingual and bilingual cognitive performance found a difference between language groups, this would also be a strong indication that linguistic skills might transfer to general cognitive functioning. On the basis of the evidence that groups of bilinguals and monolinguals differed in performance on a general cognitive task tapping into executive control (c.f. Bialystok & Martin, 2004; Bialystok et al., 2004), Bialystok and her group posed a hypothesis that
suggested that in bilinguals the inhibitory control system has been enhanced, because during language processing bilinguals would have to inhibit the non-target language. Thus, their hypothesis links the evidence for an advantage in bilingual performance to Green’s inhibitory control model on bilingual language processing (Green, 1998). However, the hypothesis relies on a number of assumptions. The first assumption is the one described above, i.e. that linguistic skills can transfer to more general cognitive functioning. Other, related assumptions concern Green’s model of language processing. The evidence that during bilingual language processing both languages are activated is compelling (see de Groot, 2011, for an overview), but it is not clear to what degree this would be the case, and whether it also implies that bilinguals have to ‘switch off’ the entire non-target language system when processing the target language. In other words, the hypothesis proposed by Bialystok suggests that bilinguals have better executive functions because they have been trained in applying them for the selection of the right lexical candidate. This idea is plausible if for this selection bilinguals rely on general inhibitory processes, but the evidence cited in the previous sections suggests that bilinguals at least to some degree also rely on local inhibition, i.e. control that is managed by a specific ‘language’ mechanism (c.f. Gollan et al., 2011).

7.4.5. Problems with replication: confounding factors.

Another problem with the interpretation of some of the evidence for a bilingual advantage in executive control, is that the hypothesis that is proposed explains the difference in cognitive functioning between the two groups by focusing only on the difference in language background, whereas there were indications that the groups may
have differed in other relevant aspects as well. There may have been differences between groups in for instance socioeconomic status, or in other demographic factors (c.f. Morton & Harper, 2009). The same problem applies to the first study that reported an advantage for bilinguals over monolinguals in older age-groups (Bialystok et al., 2004): the monolingual participants lived in Canada, and the bilinguals in India, which in itself can have entailed large differences in e.g. diet and other lifestyle factors. The data of this study were reproduced in a study by Bialystok, Martin and Viswanathan (2005), but have never been replicated.

7.4.6. Problems with replication: inconsistencies across tasks.

Finally, the results of the study by Bialystok et al. (2004) have also been questioned because of the extremely high response times that they reported, especially for the monolinguals (Hilchey & Klein, 2011, p. 637). Whereas for older adults the Simon effects that are reported are usually around 70 ms. (c.f. Kubo-Kawai & Kawai, 2010; Van der Lubbe & Verleger, 2002), the Simon effects for the monolinguals reported in Bialystok et al.’s study were sometimes between 1,000–1,800. One study (Goral et al., 2015) that claims to confirm the advantage for bilinguals that was found by Bialystok et al. (2004) differs hugely in the size of the Simon effect, while the same age-groups are concerned. Another recent study that found an advantage for bilinguals in a Simon-task (Woumans et al., in press) shows, surprisingly, that this advantage is not due to faster response times by the bilinguals on incongruent trials, but by the relative speed of the monolinguals on especially the congruent trials. All the bilinguals, but especially the balanced ones and the interpreters, are so slow on the congruent trials of the Simon-task – but, remarkably, not on the
congruent trials of the ANT-task – that even though they are also slower on the incongruent trials, they show a smaller Simon-effect. This makes it doubtful whether the advantage that this study reports for the bilinguals is caused by the same underlying mechanism that was hypothesized by Bialystok and her colleagues. It shows that even when studies in this field are reportedly in agreement in the sense that they find a bilingual advantage in the same task, there are still huge inconsistencies. Such inconsistencies confirm Valian’s observation (2015) that it is often not clear what cognitive processes are measured by the different executive control tasks. In view of these inconsistencies across studies and the often contradictory findings (see the introduction, and for reviews Costa et al., 2009; Hilchey & Klein, 2011; Paap and Greenberg 2013; Paap & Sawi, 2014), we prefer the term ‘bilingual advantages’ to ‘the bilingual advantage’. The concept of ‘bilingual advantages’ may then refer to positive differences between any specific bilingual group and a group of monolingual controls in any task assessing cognitive functioning, and may or may not be generalizable to other bilingual groups.

7.4.7. Generalizability of task results to other contexts.

Considering the above, it is crucial that for studies comparing bilingual and monolingual performance, we should aim to create groups that are as homogeneous as possible in as many aspects of their language background (e.g. frequency of use, number of languages spoken etc.) as possible. Of course, this also depends on the research question(s) we want to answer. However, even in relatively homogeneous groups, differences between bilinguals in language aspects that have not been taken into account might influence task results. In order to investigate to what extent these individual differences may play a role in task
performance, it is possible to perform within-group analyses. In our study, we performed analyses within our fairly homogeneous group of early bilingual Frisians (see chapter 3), but not for the other two groups. However, we controlled for the languages the bilinguals were proficient in, and in the case of the late bilinguals, for the age after which they acquired their L2. Additionally, we controlled for a multitude of demographic factors, as we have shown in sections 4.5.1 and 5.3.1. What follows from these observations on the multiple aspects of bilingualism and on the variability within groups, is that the results from studies on bilingualism can never a priori be generalized to other bilingual contexts. The main question at the heart of the interpretation of the results of this study is therefore in how far it is likely that the differences that we found between the bilingual and monolingual groups are also results of the factor bilingualism.

7.4.8. First account for differences between language groups in general cognitive performance: enhancement by bilingualism of executive control.

The first explanation we can propose for the observed differences in general cognitive functioning is that they are indeed a result of the fact that the bilinguals have been speaking more than one language, either (in the case of the Frisians) from early childhood onwards, or (in the case of the German/Dutch bilinguals) since reaching adulthood or later. This interpretation would bring our results for general cognitive performance in line with a number of previous studies, in particular those reporting differences between bilinguals and monolinguals in task-switching paradigms (Prior & MacWhinney, 2010; Prior & Gollan, 2011; Gold et al., 2013). On this account, bilinguals’ training in using several languages has apparently enhanced a number of interacting executive control processes which are also
tapped into during our task-switching test, in particular the ability to switch between mental sets and the resistance to proactive interference (a subtype of inhibitory control, see Prior and MacWhinney, 2010).

### 7.4.9. Enhancement of executive control in late bilinguals.

In the case of the late bilinguals, this interpretation would bring our results also in line with the experiments reported on by e.g. Tao et al. (2011) and by Pelham & Abrams (2014), suggesting that the age of acquisition, or the duration of the bilingual experience, are not crucial for the presence of a bilingual advantage. As we argue in chapter 4, it is even possible that acquiring and actively using an L2 at a later age is such a challenging experience, that it can result in an enhancement of the cognitive system (c.f. Valian, 2015). On such a view, it could be the amount of effort involved in switching between languages and/or suppressing the non-target language, rather than the amount of experience that would lead to cognitive enhancement. This would be in line with the results recently reported by Goral, Campanelli and Spiro (2015): in a study involving older (50-84) Spanish-English bilinguals, they found that balanced bilinguals showed age-related decline on a Simon task, but dominant bilinguals showed little or no age-related change. The authors suggest that this advantage in inhibition of the dominant (i.e., unbalanced) bilinguals over the highly proficient (i.e., the balanced) ones may be due to the fact that balanced bilinguals may have less need to practice inhibition because their linguistic systems may have become more independent already.
7.4.10. Inconsistency in the first account of the bilingual advantage, and possible explanations.

However, as we pointed out in both chapters 4 and 5, the advantage that we found for our bilingual groups was most pronounced in older adults, and hardly visible in the middle-aged participants. It is possible that effects of bilingualism could be more visible in elderly age-groups, because this age-group often has a lack of other challenging experiences that may have a positive effect on executive control efficiency (cf. Valian, 2015). Bialystok et al. (2005) argued that effects of bilingualism are only or most clearly discernible in age-groups where executive control is either in development (childhood) or in decline (the elderly). Still, it is hard to account for the inconsistency between our study and the one by Prior and MacWhinney (2010), who reported an advantage for bilinguals over monolinguals in college students. Still, as we argued in chapters 4 and 5, it is possible that the configuration of our task was not challenging enough for (some of) our middle-aged participants, because we had to make the time-intervals between the presentation of the cue and the target, and between that of the target and the start of the next trial, long enough for elderly participants. This may have resulted in a ceiling-effect for our middle-aged participants that could ‘mask’ a potential difference between language-groups in switching costs.

7.4.11. The second account for differences between language-groups in general cognitive performance: confounding factors.

However, it is also possible that the difference in efficiency of executive control that we found between the bilinguals and monolinguals is confounded by other factors, and that it
cannot be attributed to the fact that one group was proficient in more than one language, and the other one was not. As we pointed out in chapters 4 and 5, even when both linguistic and demographic factors are controlled for, it can never be ruled out that a factor that we are not aware of has affected the results of a group study. To make matters more complicated, the same argument can be used, but the other way round, for the middle-aged participants in our study: they too are likely to have differed in more aspects than language background alone, which may have “overshadowed” a possible group difference in cognitive functioning. This links up with Valian’s observation (2015) that bilingualism may be just one of a multitude of factors – such as musical skills, computer gaming experience, and physical exercise – that could have the potential of affecting executive control. In studies involving elderly participants it may even be harder to control for confounding factors, because our knowledge about our participants’ pasts is limited. Although the elderly are often treated indiscriminately as one homogeneous group (see for theories about “ageism” e.g. Coupland, Coupland & Giles, 1991), differences between individuals tend to become larger with increasing age, particularly because of a cumulative effect of different lifespan experiences (but see Myerson, Robertson & Hale, 2007, for opposite views). In other words, in groups of elderly participants the intra-individual variability maybe so high that we should be extra cautious to attribute a difference between two groups to one particular factor – in our case “bilingualism”.

7.4.12. Immigrant status.

One of the factors that has recently been named as possibly playing a role in studies comparing bilingual and monolingual groups is immigrant status. It is obvious that
immigrants often have different language backgrounds than people who were native-born in that country, but other differences may be relevant as well. Immigrants may either be refugees, so that we may be dealing with individuals with traumatic life-experiences, but they may also belong to a group that showed special initiative to emigrate to a foreign country, and possibly even had to pass a health-screening test to be admitted to the immigration country (Kennedy, McDonald & Biddle, 2006; Fuller-Thomson & Kuh, 2014). However, it is hard to find people who became bilingual after puberty and were no immigrants, unless they became proficient in an L2 because of formal schooling, and this factor, because it relates to the amount and type of formal education they received, may also set them out from other groups.

7.4.13. Main conclusion from findings on general cognitive task.

We can conclude that our study did find evidence for a significant difference between both early and late bilinguals and monolingual controls in a nonverbal cognitive task tapping into executive control, in particular the ability to shift between mental sets. In addition, our study associates bilingualism with a modulation of age-related decline in elderly bilinguals. As we pointed out in chapter 2, the distinction between bilingualism and monolingualism is not binary, but should rather be seen as a gradual scale in a variety of linguistic aspects. Since we controlled for the cognateness of the languages involved, this study contributes to our knowledge about possible effects of being bilingual in languages that are typologically closely related.
Lastly, the relative homogeneity of our early bilingual group enabled us to perform a number of within-group analyses in which we could focus on language background. As we have shown in chapter 2, we found a significant correlation between the variable ‘language balance’ and the efficiency in switching between mental sets. Because this within-group analysis is less vulnerable to effects of confounding variables than a group study which compares participants from different populations, this evidence for an effect of speaking more than one language on general cognitive functioning is compelling. Recently, a few more studies have been published that focus on specific aspects of bilingual language use by means of within-group analyses. Verreyt et al. (2015) show that self-reported amount of language switching (which was highest in a group of balanced bilinguals) is positively correlated to an advantage in executive control, particularly conflict resolution. But not all studies report advantages for balanced over dominant bilinguals: Goral et al. (2015), report that dominant, not balanced bilinguals, showed an advantage in executive control, in that there was little or no age-related decline in conflict resolution. The latter finding contradicts both Verreyt et al.’s and our findings for balanced and unbalanced bilinguals. This shows that even when we reduce the number of confounding factors by analyzing participants from one population, this is no guarantee that the results of these studies will be in agreement. More than that, it shows that there is a strong need for valid, sensitive research instruments, such as questionnaires that can provide detailed pictures of participants’ language background and life-style patterns. In this respect, this study has tried to make a valuable contribution.
7.5. Linguistic performance: the verbal task.

As we argued before, in contrast to studies on general cognitive performance, studies comparing linguistic performance between bilinguals and monolinguals generally agree in finding one or more disadvantages for the bilingual groups. It is remarkable that we did not find any of these, and that on phonological fluency we even found an advantage for the bilinguals, i.e. an association between bilingualism and a modulation of the age-related decline in lexical production. In the interpretation of these results, we would first like to observe that here, just as for the general cognitive task, we can never be sure whether the differences between the groups can entirely be attributed to the factor bilingualism. Moreover, because of the verbal nature of the test, we can certainly not generalize the results to other types of bilingualism, for instance to bilinguals who are fluent in different language pairs. In this case it makes more sense to explain our findings by considering the sample-specific characteristics of the bilingual group, in particular by the strong typological relatedness of the languages they were proficient in.

7.5.1. Semantic fluency

On semantic fluency, bilinguals and monolinguals produced the same numbers of words. This contradicts most previous research (Rosselli et al. 2002; Gollan et al. 2002; Portocarrero et al. 2007; Sandoval et al. 2010; but see Bialystok et al. 2008, who also reports similar performance for a bilingual and a monolingual group), which usually reports an advantage for monolinguals over bilinguals in this task component. As we argued in chapter 2, performance on this task depends to a large extent on the inherent organization of the participant’s semantic knowledge (see Portocarrero, Burright and Donovick 2007,
Sauzéon et al. 2011). As we showed before, Sandoval et al. (2010), proposed three possible reasons why bilinguals would be disadvantaged in lexical production, the first one being a smaller vocabulary size. It is certainly possible that the bilinguals in our study had a smaller vocabulary than the monolinguals. However, it should be noted that Dutch, the test language of the bilinguals, is the majority language of the bilinguals’ environment and the language of education, and that therefore all the bilinguals were highly proficient in that language. Moreover, many of the concrete nouns that were the lexical candidates in this task are exactly or nearly the same in Dutch and Frisian. Therefore, the bilinguals in our study might have been hampered less, or possibly not at all, by a relatively small vocabulary size than bilinguals in other studies.

The second reason proposed by Sandoval et al. why bilinguals would be disadvantaged in verbal production was the weaker-links account. The fact that so many lexical items are shared between the languages of our bilinguals makes it also less likely that a particular word is activated less frequently in a bilingual than in a monolingual speaker. Therefore, the Frisian/Dutch bilinguals in this study would not be expected to have slower lexical access caused by frequency-in-use effects. The fact that the bilingual group in our study produced more words in semantic clusters, and also larger clusters than the monolinguals, is remarkable. It implies that this specific group of bilinguals does not have a disadvantage compared to monolinguals related to vocabulary size or the activation of lexical items within a semantic field.

The third reason that Sandoval et al. proposed for possible differences in lexical production between bilinguals and monolinguals was the between-language interference account. However, language interference has probably played a relatively small role in the
current study, because if a word is the same in both languages, there can hardly be any interference from the non-target language while that word is being produced in the target-language. Remarkably, the late bilingual Germans, whose performance on the verbal fluency test is not included in this study, frequently reported to the research assistant that they were hampered in their performance (in German) because of interference by lexical items in the non-target language (Dutch). The Frisians never mentioned such an effect. However, in one condition (‘jobs’ in semantic fluency) they were given the choice to produce words in either Dutch or Frisian. They seldom used this opportunity and only produced Dutch items, because they suggested it would be confusing to switch between their languages.

7.5.2. Age-related effects in semantic fluency.

As regards age-related effects, our study can confirm a general age-related decline in semantic verbal fluency performance (Troyer 2000; Acevedo et al. 2000), with a similar age-related decline for both language-groups. On the one hand, based on evidence that bilinguals suffer for instance more tip of the tongue experiences than monolinguals (cf. Gollan & Acenas, 2004), and that these problems are also typically associated with increasing age, we would have expected an interaction here between bilingualism and aging. On the other hand, our finding confirms the hypothesis proposed by Gollan, Fennema-Notestine, Montoya & Jernigan (2007) that the decline in lexical access in older age might not be stronger for bilinguals than for monolinguals. We propose that again sample-specific characteristics of our group may have played a role here.
The age-groups also differed in the processes of clustering and switching. Elderly participants had significantly higher cluster ratios than middle-aged ones, and also a larger mean cluster size. This may reflect a decline in mental flexibility, resulting in a reduced ability to switch between different word clusters. At the same time, it may reflect larger semantic networks (see Park et al., 2002, for evidence that vocabulary size grows with increasing age), which would enable elderly participants to produce more lexical items within one semantic cluster.

### 7.5.3. Phonological fluency.

On phonological fluency, middle-aged bilinguals and monolinguals produced the same number of words, but whereas there was a significant age-related decline for the monolinguals, the elderly bilinguals produced as many words as the middle-aged bilinguals, and significantly more than the elderly monolinguals. The absence of a disadvantage for the bilinguals is not so surprising when we consider that the majority of previous studies found such a disadvantage in bilingual performance on semantic rather than on phonological fluency (e.g. Portocarrero, Burright & Donovick, 2007). The main explanation for the relatively better performance by bilinguals on phonological fluency is that it would depend more on inhibitory processes and effortful search strategies than on the organisation of semantic knowledge and vocabulary size. This theory was confirmed by Bialystok et al. (2008), who report that in one study the bilingual disadvantage on phonological fluency disappeared when vocabulary size was controlled for, and that in a second study a group of highly proficient bilinguals outperformed both low-proficient bilinguals and monolinguals.
When considering the analyses of clustering and switching, we can see that there was a trend for the bilinguals to have higher cluster ratios than the monolinguals, implying that they made more clusters. For the phonological trial with the highest word-scores, this difference was even significant. Since cluster ratio was positively related to overall performance, we can conclude that the bilinguals employed a better strategy to retrieve words than monolinguals.

### 7.5.4. Age-related effects in phonological fluency

As regards age-related effects, our study showed that only the monolingual group showed an age-related decline for the word score on phonological fluency. As far as we know, this is the only study finding this association between bilingualism and a modulation of age-related decline. Bialystok et al (2008) found an advantage in phonological fluency performance for a young group of high-proficient bilingual students, but in an experiment reported on in the same paper, a group of elderly monolinguals outperformed bilingual counterparts, without interaction between age and bilingualism.

We suggest three possible explanations for the relatively high performance of the elderly bilinguals in our study. In the first place, the bilingual experience may have boosted their general cognitive functioning, in particular inhibitory processes. The second possibility is that especially our elderly group may have used better search strategies. This possibility seems likely when we take into account that the bilinguals had higher cluster ratios than the monolinguals, a measure that is positively correlated with overall performance, and that the elderly also had higher cluster ratios than the middle-aged groups. We propose that the use of better search strategies is possibly related to better developed metalinguistic awareness.
A number of studies report higher metalinguistic awareness for bilinguals, and observations during testing confirm the impression that the bilinguals were much more concerned with language. Last, it is always possible that our results are confounded by other, non-linguistic factors. As pointed out in chapter 3, besides age, education seems the main predictor for performance on verbal fluency tests.

7.5.5. Summary verbal functioning.

In summary, our study found a difference in linguistic functioning between the early bilingual group and the monolingual controls. Contrary to what could be expected from earlier research, we did not find any disadvantage for the bilingual group. The bilinguals even performed better, in that elderly bilinguals, unlike their monolingual counterparts, did not show an age-related decline on phonological fluency. We propose that this advantage may have been caused by either better inhibitory functions or by a better word search strategy, reflected by the fact that bilinguals produced relatively more clusters, a measure correlating positively with word scores.

It is remarkable that both in the general cognitive task and in the verbal task elderly, but not middle-aged bilinguals significantly outperform the monolingual controls. These associations between bilingualism and a modulation of age-related decline in cognitive functioning lead us back to the final research question of this study. This concerns interactions between general and verbal cognitive performance. More particularly, we addressed the hypothesis whether the same mechanism, i.e. language interference, might explain both potential bilingual disadvantages in verbal performance and advantages in general cognitive performance.
7.6. The interaction between the general cognitive task and the linguistic task.

As we reported in chapter 3, correlation analyses within the group of early bilinguals showed significant correlations between performance on semantic fluency and its subtask, category switching, and on the task switching test, implying that participants producing a higher number of verbal responses were less troubled by having to switch between tasks. In chapter 3, we proposed that this association between lexical retrieval and executive control suggests that the bilinguals’ disadvantage in verbal performance and their advantage in nonverbal cognitive performance could be results of the same underlying mechanism. We agree with Bialystok’s Interaction Hypothesis (2008, p. 870) in so far that apparently bilinguals with the most effective control processes (that is, those who perform best on the task-switching test) do also perform best on fluency tests. However, this interaction does not necessarily imply that the relatively high performance of these bilinguals is a result of the fact that their well-developed executive control abilities enable them to cope better with lexical competition. As we already suggested in chapter 3, the interaction between the early bilinguals’ performance on the task-switching test and the semantic fluency tests seems to be mediated by working memory. This implies that individuals with higher working memory capacity tend to perform better on both task switching and semantic fluency tests. Still, our analyses of the processes of clustering and switching show that performance on semantic fluency tasks depends partly on the ability to switch between mental sets as well. This may be another reason why good switchers (that is, in general cognitive switching tasks) also perform well on these fluency tasks.