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Exploring Task-Switching In Indonesia's Multilingual Context

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ABSTRACT: The factors modulating the emergence of a bilingual advantage remain a topic of debate. While previous studies have adopted stark disparity of language experiences between language groups of interest, this study takes a different approach by examining bilingual and trilingual Indonesian participants, leveraging their unique characteristics of a multilingual context. This study aims to test whether a less distinct difference in language experiences between groups affects task-switching performance. Data were collected using the task-switching paradigm and The Language Experience and Proficiency Questionnaire (LEAP-Q), while data analysis was conducted using two-way ANOVA. Results suggested no statistically significant difference in task-switching performance between the two groups. This study suggests the implications of cultural context in modulating these results, emphasizing the significance of cultural diversity and linguistic complexity in the broader scope of multilingual trends in executive control research. The findings contribute to the ongoing discourse on the role of language experience in cognitive flexibility, highlighting the need for further research into the impact of multilingual environments on cognitive processes across different cultural and linguistic settings.

Keywords: executive control, task-switching, multilingual, trilingual, bilingual

INTRODUCTION

Imagine the brain as a web browser with multiple tabs open. Each tab represents a different task, like writing a report, planning a vacation, and keeping an eye on social media. While we can keep these "tabs" open in the background, switching between them requires a certain level of refocus to reload the information needed for these individual tasks. Our ability to navigate a complex world requires constant mental juggling similarly to that of this analogy. We switch between tasks, thoughts, and environments throughout the day. This seemingly effortless process, however, involves intricate cognitive mechanisms that have long been a subject of extensive research.

Switching, or widely known as task-switching, is a cognitive ability to switch between several mental sets as similarly depicted in the previous scenario. It operates as a member of a higher-order thinking system called executive control alongside inhibition and monitoring abilities (Miyake et al., 2000). An interesting line of research investigating what makes up this specific executive function is language experience, suggesting that processes involved in task and language switching may have some level of overlap. A significant basis establishing this notion was proposed in Bialystok et al. (2006) that bilinguals (two language users) may have improved their executive function by having to constantly switch between two different languages, which was subsequently validated by further studies (refer to Bialystok et al., 2012, for a review). One relevant study was conducted by Prior and MacWhinney (2010) using a task-

switching paradigm to compare switching abilities between bilingual and monolingual (one language users) young adults. Their findings were among the first to provide empirical evidence of a bilingual advantage in task-switching, demonstrating that bilinguals exhibited faster reaction times (RT) and higher accuracy compared to monolinguals.

In recent years, significant advancements regarding this interesting line of study proved quite progressive. A recent review proved the existence of partially overlapping neural mechanisms that are responsible for language control and executive control, specifically in neural circuits involved in bilingual language control and executive control (Jiao et al., 2022). It was also found that the bilingual experience had undeniably shaped the human brain to accommodate the constant need for language switching. Grundy et al. (2017) demonstrated that bilinguals exhibit a more efficient processing of switching by relying more on subcortical or posterior regions rather than frontal regions as typically associated with executive control. Various replications of the original bilingual advantage have also been conducted. However, reviews showed that behavioral results throughout replications remained inconsistent despite robust neural findings of bilingualism directly altering certain brain functions. A behavioral review by Paap et al. (2019) revealed that statistically significant bilingual advantages are in a clear minority, suggesting the potential absence of this bilingual advantage. Similarly, a neural review examining ERP signatures of this advantage also resulted in uncertainty (Cespón & Carreiras, 2020).

A study that can provide counterarguments to these findings was that of Grundy (2020), suggesting that albeit how rare these advantages would emerge between the two language groups, they are still more likely to favor bilinguals in advantage. It is probable that discrepancies in the cognitive processing demands of each task may have contributed to these inconsistent results, consistent with how bilingual advantages were found evident only in certain types of executive functioning tasks (Ware et al., 2020). However, it could also be the case that inconsistencies in how language groups were classified across studies contributed to these failed replications of the bilingual advantage, as there has yet to be a standardized procedure for classifying language groups (as of the time of the development of this study) (Grundy, 2020). Further studies on how language experience shapes the bilingual advantage, extending on the linguistic aspects, might prove essential for a deeper understanding of this complex issue. Thus, the present study aims to explore this topic by attempting to replicate the bilingual advantage in a population rich with different linguistic patterns.

Indonesia is the second most linguistically diverse nation in the world (Zein, 2018). According to data from Ethnologue (Eberhard et al., 2024), Indonesia is home to a total of 720 established languages, with Indonesian as the national language and the majority being regional dialects. It is also worth mentioning that these have not yet included foreign languages such as English as a lingua franca and other popularized foreign languages. While a more in-depth exploration of this linguistic diversity will follow in a separate section, this short introduction should adequately offer a glimpse into this incredible diversity.

What makes this population particularly interesting is its potential to enrich the topic with its diverse linguistic composition, offering possibilities to uncover different dynamics that might affect the existence of this advantage. Previous studies on this topic have consistently focused on a stark contrast between language groups. For instance, the original study by Prior and MacWhinney (2010) compared native English monolinguals with no exposure to any languages before the age of twelve, to highly proficient bilinguals who had been continuously using both languages since the age of six. Branzi et al. (2018) compared strictly native Spanish monolinguals to highly proficient Catalan-Spanish bilinguals, while Wiseheart et al. (2016)

considered only monolinguals with no sustained experience with a second language. These criteria were designed to create a clear distinction between groups, which were understandably necessary for the sake of analysis. However, areas between these distinct groups remained unexplored. Deviating from this trend might yield interesting results that could either complement or challenge previous findings, or even lead to entirely new discoveries. This approach highlights the potential that the Indonesian population may have the means to provide. To further understand the kind of analysis and results that can be derived from this population, it is important to firstly examine the linguistic composition of the Indonesian population itself.

Multilingualism and language diversity in Indonesia

In recent years, monolinguals are increasingly decreasing while multilinguals are becoming more prevalent (Alonso et al., 2017), Indonesia is no exception to this trend of development. Before detailing evidence of this multi linguistic context in Indonesia, it is important to realize the linguistic terms used in this study. Multilingualism is defined in its generic term as the use of two or more languages by a language user, which would make bilingualism—use of two languages—an instance of a multilingual experience. It was also suggested that both multilingualism and bilingualism can coexist as different terms as per commonly shown in research, this would define bilingualism as the use of two languages while multilingualism as the use of three or more languages (Aronin & Singleton, 2008; Cenoz, 2013; De Bot, 2019). This study will adopt the term multilingual to encompass both bilingual and trilingual (use of three languages) experiences. Limiting multilingualism to a maximum of three languages aims to provide simpler and more focused analyses, as studies on experiences involving more than three languages are still rare and not worth exploring in detail at this time.

Another important thing to note is that these terms mainly assume the use of standard languages, which is a widely recognized variety or an official form of language such as English or Indonesian. Dialects are a variety of these standard languages, meaning that they share some core features to each other. It is important to realize this as the analysis of this study includes both regional dialects and standard languages. Though having similarity in its features might mean that speakers of a standard language with its dialectal variety may not effectively represent standard bilinguals, they can be argued to have a level of similar standing to each other. A study by Kirk et al. (2018) proved that these bi-dialectals speakers can recruit language-switching control mechanisms in similar ways as bilinguals, presenting them somewhat equally.

Furthermore, it is also important to note that language experience is a highly complex phenomenon. No individual can ever be perfectly monolingual or bilingual, and that these language groups were never a categorical experience but had to be treated as such for it to be part of a research design (Bialystok et al., 2012). To provide a quantifiable boundary between language groups, threshold levels for specific aspects of the language experience can be established and personalized depending on research needs (examples of this approach can be seen in Kaushanskaya et al., 2019). This study will assign groups based on participants' level of proficiency, similarly to a method used in a relevant study by Shulley and Shake (2016).

Moving forward to discussions centering the Indonesian population itself, a crucial aspect to highlight is the widespread multilinguistic exposure among its citizens. Data from the Long Form Population Census 2020 by the Indonesian Central Statistics Agency (Badan Pusat Statistik Indonesia, 2023) indicated that exposure to a second language should be inevitable for the majority of Indonesians. Approximately 74% and 72% of the population reported usage of regional dialects within their families and relatives, respectively. Combined

with an inevitable use of Indonesian as the national language at 97%, it becomes evident that the proportion of individuals exclusively exposed to only one language should be relatively minimal.

Aside from the persisting culture of dialect use in familial and close social interactions, having mandatory linguistic subjects present in formal education may have also contributed to this conclusion. These assertions were further supported by data collection results, though it is to be discussed in another section of this study. Some of these designated languages for mandatory linguistic studies include English and various regional dialects such as Javanese, Sundanese, Balinese, Batak, and Buginese. English remains as the most popular of these languages, showing consistent growth in popularity and usage throughout the years (Zein, 2018). However, this increase does not equate to proficiency, as data from EF English Proficiency Index (EF Education First, 2023) reported a considerably low proficiency score for the overall population. Analyses elaborated throughout this section raises a subject of reflection whether most Indonesians would be categorized as bilinguals or multilinguals. Unfortunately, comprehensive statistics and studies defining these language groups remain sparse while a deeper analysis to investigate this topic falls outside the scope of this study, hence it would be difficult to conclude. Uncertainty regarding this matter should nonetheless be acknowledged, as it suggested that replicating the traditional monolingual-bilingual comparison may not be feasible.

Insights from this section provide expectations that could influence the direction of this study. It is indicated that most Indonesians are likely exposed to multiple languages due to the prevailing custom of regional dialect use, increasing use of English, and various mandatory language education programs. This widespread exposure consequently implied two main points: true monolinguals may prove to be quite rare and challenging to find for purposes of analyses, and each of the language groups proposed in this study may show a closer resemblance to each other instead of showing disparity. The latter was specifically due to the seemingly similar linguistic experiences throughout the population in this context. A majority of the population may have acquired dialects from their families in addition to Indonesian as a mandated national language, making them inevitably bilingual. Even if they did not acquire these dialects, they still had a good chance to acquire them through formal education, consequently making them multilinguals if not bilinguals. These distinctive characteristics are an important foundation that could influence the findings and analysis of this study.

The present study

The focus of this study weighing more on representing the linguistic context of the population instead of targeting disparity between groups was initiated to explore if this method would yield new findings. One particularly interesting investigation that can be derived from this population dynamic is instead of trying to understand what could replicate the bilingual advantage, perhaps understanding what could *not* replicate this advantage may provide support to the ongoing debate. Aforementioned studies have emphasized stark differences between language groups, often requiring monolingual individuals to have the most minimal exposure to a second language as possible (Prior & MacWhinney, 2010; Branzi et al., 2018; Wiseheart et al., 2016). However, replicating this requirement in the population would prove quite challenging as previously detailed. True monolinguals may be rare, while all of the language groups proposed in this study may share a closer resemblance to each other as they derive from the same upbringing. Thus, it can be expected that if an advantage were

to be replicated in this scenario, differences between the groups may prove insignificant, similarly to the case of balanced and unbalanced bilinguals (Verreyt et al., 2016).

This study will attempt to replicate the original bilingual advantage on task-switching, followed by additional analysis of multilingual (bilingual and trilingual) effects on task-switching. The subsequent analysis was proposed based on the expected prevalence of multilingual participants supported by recently shifting trends of research from bilingualism to multilingualism (Alonso et al., 2017), presenting as an imperative for this study. Analyses will be collapsed for all non-Indonesian languages reported, regardless of them being a dialect or an entirely foreign language. It was previously stated that bi-dialectals and bilinguals can be presented equally in terms of language-switching (Kirk et al., 2018). A relevant study by Antoniou and Spanoudis (2020) which tested executive control in bi-dialectals provided further support to this claim, suggesting that bi-dialectals share a closer resemblance to bilinguals in their performance. The initial hypothesis proposed in the present study is similar to that of the original study by Prior and MacWhinney (2010), which supported the notion that bilinguals will show an advantage in task-switching compared to monolinguals. Despite the recent debate questioning the existence of this bilingual advantage (Paap et al., 2019), it can be argued that bilinguals are more likely to demonstrate an advantage when differences do emerge between the two groups (Grundy, 2020). This supports the notion that the bilingual advantage persists, affirming confidence in the proposed hypothesis. In addition to this hypothesis, it can be expected that bilinguals may not show significant difference in task-switching as compared to monolinguals, even if this advantage does emerge.

If the number of monolingual participants remains few, as precedingly expected, analysis will shift its focus to the remaining multilingual groups. Assuming a majority of the population to better fit the bilingual-trilingual criteria, a comparison between the two groups shall be the main analysis. Hypothesis for this analysis assumes that the trilingual group will show an advantage compared to bilinguals, as they may have utilized more switching with the more language they can use. No prior studies have been done to compare these groups for task-switching specifically, which would subsequently make this study the first to report their direct effects. However, there have been a few studies regarding other aspects related to executive control for reference. Schroeder and Marian (2017) found that trilinguals show larger advantages in cognitive reserve in older adults compared to bilinguals, which is a similar effect to that of bilinguals (Stevens et al., 2023). While both groups were shown to be equal in inhibitory control, Madrazo and Bernardo (2018) showed a trilingual advantage over bilinguals with a more demanding inhibitory task. The hypothesis that no significant difference in task-switching performance among the two groups shall be similarly asserted, due to the expected similarity in characteristics of the groups.

As suggested in Grundy (2020), the current focus should shift towards understanding when behavioral differences emerge between language groups on executive functioning tasks, rather than simply determining if such differences exist. Moreover, the world that we know now has been progressively developing into a more multilingual state (Alonso et al., 2017), which highlights the need to shift focus from the traditional monolingual-bilingual dynamic. Exploring these multilingual interactions are expected to yield several findings that build upon this suggestion. No significant difference between the groups would act as a direct proof that enough disparity between the groups are needed for the bilingual advantage to emerge. It would also imply that a multilingual context, as detailed in the previous section, may be the underlying cause of these groups sharing a closer resemblance to each other despite having different labels. Furthermore, cultural background and context may explain why replications

of this bilingual advantage remain inconsistent across studies. Specific cultural contexts might influence task-switching or executive control as a whole. This study aims to acknowledge this idea and highlight the importance of considering population context for a deeper understanding of the interaction between language experience and executive control.

RESEARCH METHODOLOGY

This study received approval from the Ethics Committee of the Psychology Department at Universitas Bina Nusantara. All participants were fully informed about the study's details and had signed a consent form before any data collection commenced. Additionally, information about this study was previously pre-registered and resources regarding this study were uploaded on the Open Science Framework (osf.io) prior to data collection. The OSF project for this study can be accessed via the following link: https://osf.io/dpuv6/?view_only=38e910d3b3724e3e95935408d187c2fb.

Participants were selected based on each of their suitability to a predetermined sample criteria for each language group, which were established based on proficiency and the number of languages reported by the participants. Proficiency in the target language was assessed by averaging self-reported speaking, listening, and reading scores from a 10-point Likert scale. Further explanation of this language assessment method will be detailed in a later section. At present, it is only relevant to mention that proficiency was categorized based on a cut score of 4, with scores 4 and below indicating low proficiency while scores higher than 4 indicating high proficiency. Monolinguals would consist of participants who reported only their native language or, if more than one language were reported, subsequent languages should be relatively low in proficiency. A higher proficiency for these non-native languages would have them be considered as bilinguals, though only if a maximum of two languages were high in proficiency. Participants who scored high proficiency in three or more languages shall be considered as trilinguals.

Originally, the primary focus of this study was intended to analyze only the monolingual and bilingual groups respectively, following the typical trend in this line of research. Trilingual participants were expected, though only to initially be included as additional analysis. However, data collection results indicated that no participant was able to be deemed fit to meet the monolingual criteria. These results had unfortunately been previously anticipated based on the preceding analyses of the inevitable multi language exposure experienced by a majority of the Indonesian population. Additional data collected on this matter revealed congruent results to the said analysis. Familial contexts were reported to have some level of influence on language acquisition, followed by levels of current exposure, as detailed in Table 1. Regarding language exposure through formal education settings, data suggested that all participants reported prior exposure to English through mandatory formal education, followed by a total of 19 and 22 participants reporting prior exposure to regional dialect and other foreign language studies, respectively. It can be confidently concluded that this lack of monolingual participants was not a consequence of data collection error but rather a reflection of the multilingual nature of the Indonesian population. Although deviating from the originally proposed research plan means establishing this matter as a limitation, this study will then revise its analysis based on the remaining language groups as it would alternatively provide a more accurate representation of the population.

RESULT AND DISCUSSION

Analysis will report switching and mixing costs followed by factor analyses via a two-way repeated measures ANOVA to measure effects of between and within subject factors, as detailed previously in the study's design. Results of the task-switching paradigm for both groups are presented in Table 3 and Figure 3, while relevant figures detailing the analysis will follow throughout the discussions. Analysis was performed utilizing JASP version 0.18.3.

Switching cost

Switching costs were computed by analyzing the disparity in participants' RT and accuracy between two types of trials (switch trials and non-switch trials) within the mixed-task blocks. Levene's test for equality of variance was assessed prior to the analysis, which showed no statistically significant evidence to suggest unequal variance for both switch and non-switch trials for RT, $F(1, 32) = .293$, $p = .592$; $F(1, 32) = 2.97$, $p = .094$, except for accuracy, $F(1, 32) = 3.82$, $p = .059$; $F(1, 32) = 4.18$, $p = .059$, respectively. Based on these results, ANOVA analysis can be performed assuming homogeneity of variance.

Table 1. *Mean reaction time (SEM) and percentage of accuracy for single task blocks, non-switch trials, and switch trials, divided by language group.*

		Single-task blocks	Mixed-task blocks	
			Non-switch	Switch
Bilingual	RT	813.5 (59.1)	1050.2 (71.6)	1380.5 (120.8)
	Accuracy %	96.9	92.1	94.8
Trilingual	RT	836.2 (52.6)	1052.9 (80.1)	1353.5 (79.8)
	Accuracy %	96.9	93.8	90.1

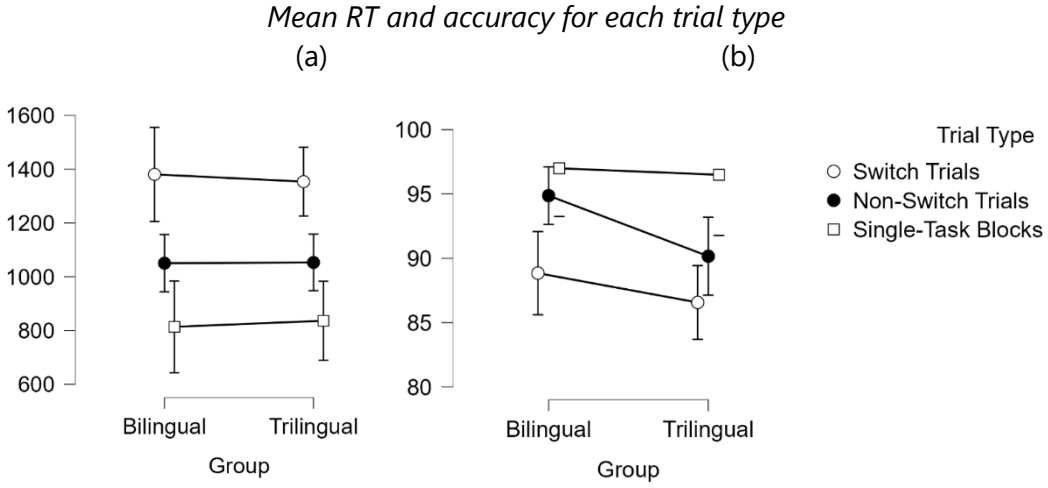

Figure 1

Note. Interactions of trial type and language group by (a) RT and (b) accuracy.

The main effect of trial type was highly significant for both RT, $F(1, 32) = 31.28$, $p < .001$, $\omega^2 = .154$, and accuracy, $F(1, 32) = 20.89$, $p < .001$, $\omega^2 = .032$, because non-switch trials receive faster and more accurate response than switch trials (as depicted by Figure 3 and Table 3). However, the interaction between trial type and language group for both RT, $F(1, 32) = .07$,

p = .794, ω^2 = .0, and accuracy, F(1, 32) = 1.33, p = .256, $\omega^2 = 5.655x10^{-4}$, was not significant. This suggested that differences in performance between switch and non-switch trials are similar for both bilingual and trilingual participants. As can be seen in Table 3, there were only 27 ms and 4.7% disparity between the two groups, with trilinguals showing slightly faster RT but lower accuracy compared to bilinguals. Analysis of simple main effects suggested that this RT, F(1) = .038, p = .847, and accuracy, F(1) = .259, p = .614, was still considered an insignificant difference nonetheless. The main effect of language groups were not significant in either analysis, F(1, 32) = .011, p = .915, ω^2 = .0; F(1, 32) = .648, p = .427, ω^2 = .0, for RT and accuracy respectively, further concluding similar performances in task-switching between the two groups.

Mixing cost

Mixing costs were computed by analyzing the disparity in participants' RT and accuracy between trials within the single-task blocks and non-switch trials within the mixed-task blocks. Single-task blocks consisted of two non-switch trial sets of each digit and letter task. Hence, analysis of mixing cost will combine results from both of these tasks. Levene's test for equality of variance was assessed prior to the analysis, which showed no statistically significant evidence to suggest unequal variance for both single-task trials and non-switch trials across RT, F(1, 32) = .043, p = .837; F(1, 32) = 2.97, p = .094, and accuracy, F(1, 32) = .101, p = .752; F(1, 32) = 4.18, p = .059. Based on these results, ANOVA analysis can be performed assuming homogeneity of variance.

The main effect of trial type was significant for both RT, F(1, 32) = 13.06, p = .001, ω^2 = .13, and accuracy, F(1, 32) = 1.206, p = .035, ω^2 = .038. As depicted in Table 3 and Figure 3, single-task trials incurred faster RT and higher accuracy as compared to non-switch trials. This is likely due to the difference in processing requirements needed to perform between the single and mixed-task blocks. The absence of need to prepare for an upcoming task reconfiguration within the single-task blocks resulted in a quicker response, compared to mixed blocks where constant reconfigurations were needed. However, interaction between trial type and language group for both RT F(1, 32) = .025, p = .875, ω2 = .0, and accuracy, F(1, 32) = 4.86, p = .280, ω2 = .002, was not significant. Similarly to that of switching cost, this suggested that differences in performance between single-task blocks and non-switch trials are similar for both bilingual and trilingual participants. The main effect of language groups were not significant in either analysis, F(1, 32) = .028, p = .867, ω2 = .0; F(1, 32) = .923, p = .344, ω2 = .0, for for RT and accuracy, respectively. These results demonstrated significant findings only for the main effect of trial type, suggesting no further conclusion aside from that mixing effects were equally costly for both groups. This indicated that both bilinguals and trilinguals were equally susceptible to the processing load imposed by the mixed-block trials.

Discussion

No overall switching effects difference between the two language groups were observed, suggesting that both bilingual and trilingual participants performed somewhat equally in task-switching. This study was, as far as the author is aware of, nonetheless the first to investigate trilingual experience in task-switching. Investigation of trilingual effects on other aspects of executive control showed similar results. A study by Madrazo and Bernardo (2018) reported equal performance between trilinguals and bilinguals for inhibition. It was subsequently noted that a trilingual advantage was however found when modulated by a more demanding inhibitory task. This is a similar finding to that of bilingual advantage, suggesting that the effects of bilingualism can be observed in settings engaging higher cognitive demands

(Hernández et al., 2013). While this could be the case for the present study, other speculations can be argued considering the unique multilingual context of the population.

Results from the present study subsequently validated the proposed hypotheses of no significant difference in performance between the two language groups, albeit calls for further investigation. One suspect mediating these results would be language exposure, as it was previously highlighted as an inevitable feature unique to the population. Referring back to Table 2, it can be observed that L3 exposure was only at 15% for the trilingual groups. Although reporting enough proficiency, this lack of exposure could suggest lack of usage, which counters the original idea underlying this line of study that an executive control advantage was the result of constantly having to switch between languages (Bialystok et al., 2006). More direct evidence of the validity of this idea was present in a relevant study by Verreyt et al. (2016). Between groups of unbalanced, balanced with frequent experiences of language-switching, and balanced non-switching bilinguals, the study concluded significant advantage only for the balanced switching group. Unbalanced and balanced non-switching bilinguals showed no significant differences in performance, comparable to the present study. With this lack of exposure, perhaps trilinguals in this study were not an extension of bilingualism but rather an experience more similar to that of bilingualism itself in terms of frequency of switching. The same can also be argued for bilinguals, as exposures for both of their languages were quite unbalanced, consequently suggesting them to share more resemblance to the monolingual experience. Aside from concluding the importance of adequate language switching experience to establish an executive control advantage, insight from this conjecture also implies evidence of language exposure equating to language usage, which would potentially facilitate frequent switching.

The average age of language acquisition in both groups was relatively early, considering the years of subsequent exposure they had until reaching their current ages. However, it can also be similarly argued that this demographic leads to the two language groups being unbalanced as reference to Verreyt et al. (2016), who had recruited balanced participants with an average of L2 acquisition not exceeding 2 years. In contrast, this study's participants had an average age of L2 acquisition at 4.9 years for bilinguals and 4.6 years for trilinguals, with the multilingual group acquiring their third language on average at 6.6 years old. It can be further argued that the two groups observed in this study were unbalanced in their language experiences. A similar demographic was observed in Branzi et al. (2018), where their bilingual group, while balanced in terms of age of acquisition, also showed some acquisition of a third language at an average of 7 years old, resembling the trilingual group in this study to an extent. Their monolingual group also similarly showed some acquisition of a second language at an average of 6 years old, closely resembling the bilingual group of this study. They've, however, found significant results while this study did not, which could be due to the more balanced nature of their bilingual group. This possibly supports the argument of unbalanced nature of the participants of this study, be it due to their level of exposure of age of acquisition.

These conclusions are particularly useful when aligned with a recurring trend present in this line of study, which have emphasized stark differences between language groups, often requiring monolingual individuals to have the most minimal exposure to a second language as possible (Prior & MacWhinney, 2010; Branzi et al., 2018; Wiseheart et al., 2016). These criteria were designed to create a clear distinction between groups, which were understandably necessary for the sake of analysis. However, this disparity was never previously highlighted and discussed. The discussions throughout this study call for attention to this obvious yet often

overlooked notion that an adequate disparity between groups may potentially influence the emergence of language effects on executive control.

Another potential factor influencing the results of this study would be the similarity between dialects and the standard language of their region. It was previously argued that bi-dialectals and bilinguals can be presented equally in terms of language-switching (Kirk et al., 2018). However, this may not be the case if the dialects reported in this study showed a significant level of similarity to the national language of Indonesian. Dialects are variations of standard languages, implying that they share some core features to each other. If these similarities are pronounced, switching between or to these dialects may not elicit effects comparable to that of switching between two distinct standard languages. It is challenging to offer direct evidence regarding the degree of similarity between these languages, therefore it is hard to definitively conclude whether this was the case. Nevertheless, this discussion highlights the significance of cultural contexts, particularly in terms of how certain language experiences are affected within the region where the study is conducted.

Taken together with previous discussions, one could argue for the effect on cultural context in modulating aspects of language experiences, which consequently might affect the level of disparity between language groups. This is particularly important considering the diversity present throughout populations, deriving from a variety of cultural backgrounds, across studies regarding this line of study. The question emerging from this notion should be whether the replications of the bilingual or multilingual advantage across studies are truly generalizable when the cultural contexts differ across studies. Two studies on executive control, where language groups are carefully presented with adequate disparity, were conducted in strikingly different contexts of Spanish (Duñabeitia et al., 2014) and Belgium (Verreyt et al., 2016) populations. Given that both studies required bilinguals to be highly proficient, acquire both languages early, and engage in frequent language switching, an advantage in executive control should ideally be expected. However, the study conducted in the Spanish context concluded null results while the opposite was concluded in the Belgium context. Although a number of speculations can be made to explain these outcomes, this comparison is evident to the potential role of cultural context in modulating these results. As referenced from the present study, the dynamic of language exposure and usage along with the potentially similar features of dialects and standard language, and subsequent multi linguistic nature of its population, may be a cultural pattern affecting no observable advantage of executive control, specifically for task-switching performance. Perhaps extending these cultural implications can provide deeper understanding of how the interactions between language experience and executive control truly manifests.

As of time of development of this study, this implication of cultural context remains underexplored, though recently starting to progress alongside the shifting trends of research from bilingualism to multilingualism (Alonso et al., 2017). Further studies exploring this matter should consider this curious role of cultural context in modulating disparity when comparing between language groups, towards a better future of understanding the effects of language experience on executive control.

CONCLUSION

One significant limitation of this study is the lack of monolingual participants. Although the multilingual nature of the population offered interesting discussions and implications, the presence of monolingual participants could nonetheless serve as a control group, providing more robust evidence regarding bilingualism and more comprehensive results when presented with trilinguals. Future replications of this study should put effort to include these rare monolingual participants within the population. Another critical setback of this study was its significantly small number of participants, which raises concern about the generalizability of this study, followed by the uneven sizes of sample for both groups. It was unfortunately challenging to fulfill this standard for many reasons, mainly due to limited resources and lack of available information regarding the characteristics of the population itself. Previous analyses of the population included in this study attempted to set expectations of the said population, but they could not have anticipated the unexpectedly high number of trilingual participants as no prior data was available to indicate this characteristic. A replication of this study targeting a bigger sample size should nonetheless be conducted in the future, which would better be supported by validating the Indonesian version of the LEAP-Q, as it has not yet been validated. Moreover, resources regarding any language experience assessment for the Indonesian context remained scarce despite the diverse linguistic nature of the population. Providing more resources for measures of language experience for the Indonesian population would subsequently enhance the accuracy and reliability of data collection, leading to more robust and generalizable findings of future replications.

Monolinguals are becoming progressively rarer, not only in Indonesia but also globally, due to the increasing exposure to and acquisition of multiple languages (Alonso et al., 2017). This trend suggests that the monolingual characteristic itself may evolve with this growing multilingual exposure. It may be time to finally consider and integrate the multilingual context for future studies, starting by acknowledging the cultural contexts of each study and providing speculations on how these contexts could influence the language experiences of their participants. Recognizing these cultural influences can enrich the understanding of how language acquisition and usage shape cognitive processes and potentially lead to more nuanced and applicable findings in the study of bilingualism and multilingualism.

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