RGC Ref No. 15605620

RESEARCH GRANTS COUNCIL

Application for Allocation from
the General Research Fund for 2020/21
Application Form (GRF1)

- **Please read the Explanatory Notes GRF2 (Aug 19) carefully before completing this form.**
- **To safeguard the interests of the researcher and the university, the awardee university bears the primary responsibility for prevention, detection and investigation of research misconduct, including but not limited to misuse of funds, data falsification, plagiarism and double-dipping. The university is strongly encouraged to vet the grant applications using anti-plagiarism software before submitting them to the RGC.**

PART I SUMMARY OF THE RESEARCH PROPOSAL

[To be completed by the applicant(s)]

1. Particulars of the Project

(a) (i) Name and Academic Affiliation of Principal Investigator (PI):

Name	Post	Unit/ Department/ University
Dr POLITZER-AHLES, Stephen	Assistant Professor	Department of Chinese and Bilingual Studies/The Hong Kong Polytechnic University

(ii) Is the PI a new appointee within 2 years of full-time paid appointment to his/her first substantive position as an academic staff in a university at the time of submission of the proposal?

Yes ☐ No ☑

(iii) Title of Project: Is the mismatch negativity really sensitive to abstract linguistic representations?

(iv) Nature of Application

New ☐ Re-submission ☑ Continuation ☐

(b) (i) Primary Field: Cognitive Neuroscience of Language **& Code** 4110
Secondary Field: Psycholinguistics **& Code** 4109

(ii) A maximum of five keywords to characterise the work of your proposal (a maximum of 30 characters for each keyword)

1) neurolinguistics
2) EEG
3) mismatch negativity
4) morphology

(iii) Project Duration: 24 Months*

*** for longer term projects, please explain in your research plan in Part II 2(b)(i) why the proposed research cannot be completed within the normal span of 36 months.**

(iv) Total Amount Requested: $ 1,005,560

(c) Abstract of Research comprehensible to a non-specialist (either a maximum of 400 words in one A4 page of PDF document in standard RGC format or a maximum of 400 words for direct input in the text box):

The mismatch negativity (MMN) brain signal is a widely used tool for investigating the neural processing of language. It remains uncertain, however, whether this component of brain activity reflects the processing of abstract linguistic features (i.e., those with no reliable physical correlates), or only that of low-level physical features. While MMN experiments have often been used to argue for the psychological reality of theoretically-motivated but abstract linguistic structures, there are often other explanations available that do not rely on abstract linguistic knowledge. The present project will more deeply investigate the mechanisms underlying the MMN, by testing whether MMN can be elicited for contrasts which are not cued by any physical correlate.

MMN can be elicited by a putatively abstract contrast, e.g., between a random sequence of unaspirated sounds (e.g., "ba", "da", and "ga") and aspirated sounds (e.g., "pa", "ta", and "ka"). It is assumed that the standards only form monolithic categories (required for the elicitation of MMNs) at a level of formal linguistic features (i.e., unaspirated vs. aspirated). However, this contrast could be explained without recourse to linguistic features: "pa", "ta", and "ka" all include a brief puff of air (aspiration) whereas "ba", "da", and "ga" do not. The present experiments will test, for the first time, whether the MMN can be elicited in contrasts that truly have no physical correlate. Experiments 1a-b will examine whether the MMN is observed for a contrast between English irregular past and present verbs (e.g., {"shake", "run", "sit"} and {"gave", "won", "lit"}), where there is no single physical cue that signals the difference. Experiments 2a-b will examine whether the MMN is observed for another contrast which has no physical cue: a contrast words from different semantic categories. If MMN can be elicited by contrasts without a single acoustic cue, this will be the strongest evidence to date that the MMN reflects automatic activation of abstract linguistic representations. This research will also help narrow

down what kinds of categorization can occur pre-attentively in the brain.

The findings will have relevance for theories and models in cognitive neuroscience, as they will either strongly reaffirm or challenge current assumptions about what the MMN reflects. The MMN is also gaining traction as a diagnostic tool in individuals with some neurodevelopmental disorders, and a deeper understanding of its mechanisms may improve its efficacy in clinical contexts or broaden its application to different clinical populations and other translational applications.

(d) Special funding template (Applicants can select more than one box)

- ☐ **Clinical Research Fellowship Scheme (Please also complete an additional form (Enclosure I) and see Enclosure II) (only available for applications under Biology and Medicine Panel)**
- ☐ **Support for Individual Research (Time-off) (see Enclosure III) (only available for applications under Humanities and Social Sciences Panel and Business Studies Panel)**
- ☐ **Longer-term Research Grant (see Enclosure IV)**
- ☐ **Employment of Relief Teacher under Humanities and Social Sciences Panel (see Enclosure V) (only available for applications under Humanities and Social Sciences Panel)**
- ☑ **Provision of Research Experience for Undergraduate Student (see Enclosure VI)**
- ☐ **Support for Academic Research related to Public Policy Developments (see Enclosure VII)**

PART II DETAILS OF THE RESEARCH PROPOSAL

[To be completed by the applicant(s)]

RESEARCH DETAILS

1. Project Objectives and Pathways to Impact Statement

(a) Project Objectives (a maximum of 800 words in total for the project objectives)

[Please list the objectives in point form]

1. To improve our understanding of the functional significance of the mismatch negativity
2. To determine whether the MMN can be elicited by abstract morphological contrasts with no acoustic correlate
3. To determine whether the MMN can be elicited by abstract semantic contrasts with no acoustic correlate

Other Information

(b) Pathways to Impact Statement (should not exceed two A4 pages)

Attached 2 pages(s) as follows

Recent decades have seen a massive surge in the amount of scientific research conducted per year, and along with this has come rapid technological advances. As a result, much of society believes that little-understood technology can tackle many issues. Stakeholders are regularly placing confidence in things like artificial intelligence, machine learning, and neuroscience to solve looming issues that the world will face in the near future. However, in many cases these sorts of applications have been rushed into use before science has completely figured out how they work. To take a few examples:

- Consumer DNA-testing services like 23andMe are widely assumed to give people accurate information on their ancestry, but in fact the results of these are estimates based on necessarily inaccurate algorithms, which has caused many people to misunderstand their ancestry and family background (see, e.g., "Are You My Cousin or Half-Sibling?" [Jane C. Hu, 2019, *Slate*, https://slate.com/technology/2019/10/23andme-family-secrets-half-siblings-cousins.html]);

- Inaccurate machine translations have led to people being wrongly arrested (see, e.g., "Facebook translates 'good morning' into 'attack them', leading to arrest" [Alex Hern, 2017, *The Guardian*, https://www.theguardian.com/technology/2017/oct/24/facebook-palestine-israel-translates-good-morning-attack-them-arrest])

- Facial recognition systems have been widely implemented even though they often contain racial biases and unacceptable false positive rates (see, e.g., "Facial Recognition Has Already Reached Its Breaking Point" [Lily Hay Newman, 2019, *Wired*, https://www.wired.com/story/facial-recognition-regulation/])

- Artificial intelligence is still woefully inaccurate for many practical purposes (see, e.g., "Bots of New York" [https://www.facebook.com/botsofnewyork/], a parody Facebook account which showcases uncannily bad machine-generated faces and text)

- Many brain-stimulation and "brain-training" devices and apps are being widely sold, despite the lack of evidence that they are beneficial and despite the fact that we still don't understand the brain mechanisms these devices purport to improve (see, e.g., "An Electric 'Humm' To Make You Smarter?" [Neuroskeptic, 2019, *Discover*, http://blogs.discovermagazine.com/neuroskeptic/2019/07/21/an-electric-humm-to-make-you-smarter/])

These examples highlight how important it is—perhaps now more than ever—for us to build a deeper understanding of the basic science behind how things work, particularly in areas where the biggest technological advances of the future are likely to come. One of the most important and least understood of these is the brain. In the upcoming years, understanding the brain is going to become more and more important; in addition to the example cited above, there are many new technological startups interested in trying to monetize, gamify, and otherwise "apply" neuroscience. The present proposal is for a series of studies that will improve our understanding of how the brain and mind work, and specifically our understanding of a particular component of brain activity: the mismatch negativity.

The *mismatch negativity* (MMN) is widely used as an instrument for investigating brain processing in many domains, such as linguistics, psychophysics, and memory, and in many

populations, such as typically developing humans across the lifespan, individuals with neurodevelopmental disorders, and nonhuman animals (for review, see e.g. Näätänen et al., 2007). MMN experiments have yielded insights into how language is represented in the brain (e.g., Eulitz & Lahiri, 2004), how memory representations are deployed during auditory processing (e.g., Näätänen et al., 2005), auditory processing in neurodiverse populations (e.g., O'Connor, 2012), and more. It has also shown promise for use as a biomarker in the detection or evaluation of various clinical conditions (Schall, 2016; Zarza et al., 2007). The ability to use the MMN for theoretical insights and clinical applications, however, depends on a robust understanding of what underlying perceptual or cognitive processes it reflects; if the MMN does not actually reflect the same processes we think it does, many theoretical assumptions that have been supported by MMN evidence could be challenged.

One widespread fundamental assumption about the MMN is that it reflects the recognition of, and/or response to, not only simple changes in stimuli but also abstract or higher-order changes (e.g., Näätänen et al., 2007). Evidence for this claim, however, is not as strong as it could be, as many MMN effects supposedly based on abstract contrasts could be explained by more low-level physical mechanisms. The present project will be the first attempt to elicit MMNs with absolutely no reliable physical correlate, and thus the strongest test yet for "abstract" MMNs.

Regardless of the direction of the result, the findings stand to have substantial impact on our understanding of the MMN. If an MMN is observed for fully abstract contrasts, this would strongly reaffirm current understanding of the mechanisms underlying the MMN, providing the most direct evidence to date that the MMN reflects abstract memory processes. On the other hand, if an MMN is not observed, this would be an even more impactful result, as it would challenge widely accepted understanding of what the MMN is and would suggest a need for substantial refinement of current theories of the MMN. The experimental paradigm for this project (see following sections on research design and methodology) is designed such to be able to statistically detect either kind of result. In the short term (1-3 years), this will benefit neuroscientists both within and outside the academy, whose research depends on a firm understanding of what components of brain activity reflect.

The study also stands to have broader, translational impacts in the longer term. The MMN has begun to be applied as a diagnostic tool in neurodevelopmental disorders and for totally locked-in patients or individuals in vegetative state. Thus, better understanding what constructs the MMN is sensitive to may allow this tool to be applied more broadly and/or more accurately. As these sorts of applications are already being developed, the results for this research will inform the development and implementation of such clinical applications (and extension of these to other clinical populations) in the coming 4-10 years. The results will also be communicated to stakeholders outside of academia who are also interested in using neuroscience to develop practical applications; the co-investigator is a former academic who is now in a game company. Finally, in the long term (10+ years), these results will contribute to a growing body of work on understanding how the brain works, which will ultimately have far-reaching implications throughout society. Most of the truly futuresque applications of neuroscience that have been imagined (e.g., reconstruction of thoughts or memories based on brain recordings, practical brain-computer interfaces for controlling everyday devices, direct brain-to-brain networking, and brain augmentation) will only come about with a massive investment in understanding the basics of brain function, and this work will form one part of that puzzle.

2. Background of Research, Research Plan and Methodology:

(a maximum of seven A4 pages in total in standard RGC format for items (a) and (b)(i); a maximum of one A4 page for item (b)(ii))

(a) Background of research

(b) (i) Research plan and methodology

Attached 7 pages(s) as follows

(b) (ii) A one-page Gantt Chart showing the research activities

Attached 1 pages(s) as follows

(c) A maximum of two non-text pages of attached diagrams, photos, charts and table etc, if any.

Attached 1 pages(s) as follows

(d) Reference (a maximum of three pages for references is allowed for listing the publications cited in Section 1-2. All full references should be provided, including all authors of each reference.)

Boersma, P., & Weenink, D. (2016). Praat：Doing phonetics by computer, Version 5.4. [Computer program]. Retrieved from http://www.praat.org/

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attentive discrimination of abstract feature conjunctions in auditory sequences. Intelligence, 40, 239-244.

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Nieuwland, M., Politzer-Ahles, S., Segaert, K., Darley, E., Kazanina, N., Von Grebmer Zu Wolfsthurn, S., …, & Huettig, F. (2018). Large-scale replication study reveals a limit on probabilistic prediction in language comprehension. eLife, 7, e33468.
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Wang, X. D., Gu, F., He, K., Chen, L. H., & Chen, L. (2012). Preattentive extraction of abstract auditory rules in speech sound stream: A mismatch negativity study using lexical tones. PLoS ONE, 7, e30027.
Zarza, D., Arce-Arce, S., Bhathal, H., Sanjuán-Martín, F. (2007). Mismatch negativity and conscience level in severe traumatic brain injury. Revista de neurologia, 44, 465-468.

(e) Output dissemination plan

Target timing of dissemination (quarter/year)	Type (Journal / Conference / Others)	Name of journal, conference or other dissemination means
1Q / 2022	Journal	Journal of Cognitive Neuroscience, or comparable (society journal of high international standing)
4Q / 2022	Journal	Journal of Cognitive Neuroscience, or comparable (society journal of high international standing)
3Q / 2021	Conference	Society for Neuroscience, or comparable (major conference including industry representatives)
3Q / 2022	Conference	Society for Neuroscience, or comparable (major conference including industry representatives)

THE MISMATCH NEGATIVITY

The brain automatically detects changes in stimuli it is perceiving. This pre-attentive change detection process is often reflected in a component of brain activity called the *mismatch negativity* (MMN), which can be measured by presenting two kinds of stimuli, one rarely and one frequently, and comparing the neural activity elicited by a rarely presented sound to that elicited by a frequently presented sound (Näätänen et al., 2007). For example, in a typical experiment, a person may hear a continuous series of sounds like *da da da da da da* ***pa*** *da da da da* ***pa*** *da da da da da da da da* ***pa*** *da da da*… The rarely-presented sound, *pa*, is called the "deviant", and the frequently-presented sound, *da*, the "standard". Even if the listener is not paying attention to the sounds, *pa* still triggers a more negative-going electrophysiological brain response when presented as a deviant than when presented as a standard; this extra negative-going component of brain activity is the mismatch negativity.

The mismatch negativity does not necessarily reflect knowledge of language; even nonhuman animals with no linguistic knowledge demonstrate mismatch negativity patterns to simple sound contrasts like that above (Näätänen et al., 2007). But the human MMN is not sensitive only to the simple difference between two unique sounds. It is also claimed to be sensitive to stimuli that don't fit a previously constructed *rule* or *category*; thus, the MMN has become a useful tool to examine how the mind abstracts away from physical details of stimuli to construct higher-level categories or rules. One piece of evidence for this derives from mismatch negativities elicited by linguistic contrasts for which the difference is located in a supposedly abstract feature.

These experiments rely on the fact that the mismatch negativity is only observed when there is a frequently-presented "standard" category—as in the above example, in which *da* is presented frequently. If there is not a single frequently-presented category—as in a stream like *da* ***pa*** *so tu la fi mu ka hi bu* ***pa*** *zee way pu li du ba* ***pa***, in which there is no single feature that all the standards have in common that distinguishes them from the deviants—then a mismatch negativity will not be elicited. A mismatch negativity can be elicited, however, when there is no single frequently-presented *sound*, but a variety of sounds that together form a category. For instance, Phillips and colleagues (2000) had English-speaking participants listen to streams of sounds in which the standards included *ba*, *da*, and *ga*, while the deviants included *pa*, *ta*, and *ka*—e.g., *ba ba ga da ba ga da da* ***ta*** *ga da ga ba da da ga* ***ka*** *ba ga* ***ta***…. In a stream like this, there is no unique standard sound, but all the standard sounds have unaspirated consonants, whereas all the deviant sounds have aspirated consonants (i.e., the deviant sounds *pa*, *ta*, and *ka* are pronounced with a puff of air after the consonant release, whereas the standard sounds *ba*, *da*, and *ga* are not). These deviants elicited a mismatch negativity effect, suggesting that participants' brains automatically detected this more abstract difference between aspirated and unaspirated categories. Similarly, Wang and colleagues (2012) presented Mandarin-speaking participants with standards and deviants that comprised a wide variety of vowels at several levels of loudness. All the standards, however, had Mandarin high-level tone, whereas the deviants had either falling tone or rising tone. A mismatch negativity was also detected in this experiment, suggesting that listeners' brains automatically detected differences in tones, abstracting across different vowels and intensities.

Studies such as these provide evidence that the mismatch negativity may be sensitive not just to low-level contrasts, but also to seemingly abstract categories. The argument is that the mind automatically attempts to sort incoming stimuli into categories, and thus an MMN elicited by a

deviant stimulus provides evidence that the previous sequence of stimuli had been organized into a more abstract category; the ability to shed light on how the mind categorizes stimuli is one of the most compelling features of the MMN. A crucial limitation of the studies supporting this conclusion, however, is that low-level contrasts were still present, and thus these findings could be explained without reference to abstract categories. For example, in the English study with aspirated or unaspirated consonants, aspiration is signaled by a physical puff of air (and its resultant acoustic correlate, an interval of aperiodic acoustic noise between the burst of a consonant and the onset of periodic voicing in the following vowel). Thus, a brain that is ignoring all other acoustic information and just focusing on the presence or absence of this aspiration interval could easily detect the contrast and produce a mismatch negativity. Likewise, in the Mandarin tone study, a brain that ignores all higher-frequency information about vowel quality, and just focuses on low-frequency changes associated with pitch, could also detect a low-level acoustic contrast and realize a mismatch negativity. Indeed, mismatch negativities of this kind—in which standard stimuli vary in many features, but one feature separates the standard from the deviant stimuli—can be observed even in non-linguistic stimuli such as beeps (Pakarinen et al., 2010), which provides further evidence that the abovementioned mismatch negativity effects may not be reflecting abstract knowledge at all. To our knowledge, all extant studies claiming to have observed mismatch negativities for abstract linguistic contrasts have this limitation. The strongest argument that the MMN reflects the construction of abstract categories would be if an MMN could be elicited for a contrast that has no reliable physical cue; in the following, this is what we mean when referring to an "abstract" contrast or MMN.

The goal of the present study is to test whether MMNs can be elicited by contrasts that are truly abstract, with absolutely no low-level physical correlates to the contrast. We do this by testing morphological and semantic contrasts that have no reliable physical correlate. Whether we observe mismatch negativities in this study or not, the results will be informative for understanding the cognitive processes underlying the MMN. If abstract contrasts do elicit mismatch negativity, this would be the strongest demonstration to date that the mismatch negativity really indexes the detection of category-level changes. On the other hand, if these contrasts do not elicit mismatch negativity, this could be evidence that the current understanding of the functional significance of the mismatch negativity is flawed. Therefore, given the potential informativeness of a null finding, we design the experiments with high statistical power and with direct or conceptual replications, in order to have more confidence in null results if they are obtained.

PREVIOUS WORK DONE BY OTHERS

In addition to the studies by Phillips and colleagues (2000) and Wang and colleagues (2012) described above, a few other studies are relevant to the question of abstract contrasts in the elicitation of mismatch negativity. Kazanina and colleagues (2006) tested an aspiration contrast (between *ta* and *da*, using a variety of tokens with different aspiration intervals) on both Russian speakers, for whom this contrast is meaningful in their language, and Korean speakers, for whom it is not. They found a mismatch negativity in Russian speakers but not Korean speakers, providing some of the strongest evidence to date that the mismatch negativity is sensitive to abstract linguistic knowledge. This finding, however, as well as those of other studies using categorical-boundary MMN effects to argue for the role of abstract linguistic knowledge, hinges on a contrast that is acoustically cued, and that acoustic cueing is mediated by abstract linguistic knowledge. In other words, abstract linguistic knowledge influences whether a given acoustic

cue will be used or not by a speaker. Kazanina and colleagues demonstrated that the MMN can be elicited, or not elicited, by an acoustic contrast whose importance to the speaker is determined by its status in the speaker's abstract phonological system. This study indeed provides evidence that the MMN is reliant on how stimuli are categorized in an abstract phonological system, but it does not yet show that the MMN can be elicited by abstract category distinctions without any physical cue, since the contrast tested is uniquely signaled by a physical cue (aspiration). Thus, the present study will go a step further by testing whether the MMN can be elicited by an abstract contrast with no physical cue at all, as opposed to being elicited by a physical cue that is made more or less important by abstract linguistic knowledge.

A recent unpublished study by Monahan and colleagues (2019) is also relevant. Monahan and colleagues presented English-speaking listeners with standards and deviants that were distinguished by a phonological cue which has variable acoustic realization. Specifically, the difference between standards and deviants was that one set was phonologically voiced (e.g., /ba, da, ga, va, za/) and one was phonologically voiceless (e.g., /pa, ta, ka, fa, sa/). In American English, the distinction between voiced and voiceless stops (/b, d, g/ vs. /p, t, k/) is typically realized mainly by duration of aspiration ("voiced" /b/ is actually usually voiceless and unaspirated in word-initial contexts). On the other hand, the distinction between voiced and voiceless fricatives (/v, z/ vs. /f, s/) is realized by vocal fold vibration. Therefore, in this study, the standards and deviants were distinguished by an abstract phonological cue but not by any unique acoustic cue. Monahan and colleagues still found MMN in this situation, suggesting that MMN can be elicited by abstract phonological contexts. Although it is not yet published, this study is highly relevant to ours (indeed, previous versions of our proposal submitted in 2017 and 2018 also proposed doing precisely this study; the fact that other accomplished international scholars also thought of this is a testament to the importance of this issue). However, it only provides evidence for the use of abstract *phonological* information in the generation of the MMN. Our proposed study will push beyond phonology and see if the MMN is also sensitive to abstract distinctions at other levels of processing, which will be useful for helping to establish what kinds of linguistic categorization can occur pre-attentively and what kinds require attention.

Some studies have found that the MMN can be elicited by a deviant that does not fit a rule, rather than a category; e.g. when a sequence of standards is continually falling in tone from one standard to the next, but then the deviant has a higher tone than the preceding standard (Tervaniemi et al., 1994), or a multi-feature rule (e.g., standards have frequency and intensity varying in direct proportion whereas deviants have frequency and intensity varying in inverse proportion; Houlihan & Stelmack, 2012). These sorts of studies have a similar limitation as the studies discussed previously: the rules or categories are always cued by a physical correlate (e.g., steadily rising tone across a series of deviants, or ratio between stimulus frequency and intensity), which the brain might recognize without abstracting away from physical features.

Numerous studies have observed mismatch negativity for contrasts between syntactically correct phrases and phrases with syntactic or morphosyntactic grammatical errors (Hasting et al. 2007; Hermann et al., 2007; Pulvermüller & Assadollahi, 2007; Pulvermüller et al., 2008; Shrytov et al., 2003). But while these might at first glance seem like evidence for MMN sensitivity to abstract linguistic contrasts, they actually are not, because they also rely on a unique acoustic correlate that cues the syntactic contrast—e.g., comparing the German grammatical phrase *ein Falter* ("a butterfly") with the German ungrammatical phrase *ein faltet* (*"a folds"), where the

difference is uniquely cued by the final consonant and thus the brain response may reflect detection of acoustic change rather than detection of abstract category change.

PRIOR WORK AND PREPARATION BY THE PI

An experiment using Mandarin tones in a variety of vowel contexts (Politzer-Ahles et al., 2016), similar to that by Wang and colleagues (2012), found mismatch negativity for tonal contrasts; furthermore, like Kazanina and colleagues (2006), we only found this mismatch negativity response in Mandarin speakers and not in non-Mandarin-speaking participants. Similarly, in an experiment in Russian (Schluter et al., 2017), we mixed together several different voiced and voiceless fricatives, similar to the paradigm of Phillips and colleagues (2000), and observed mismatch negativities in Russian speakers. These studies suggest that the brain may be sensitive to abstract contrast. Just like all the other studies summarized above, however, these experiments relied on physical acoustic cues.

We have also conducted other mismatch negativity experiments not directly examining this particular kind of abstractness issue (Politzer-Ahles, ms.; Politzer-Ahles & Im, 2019; Schluter et al., 2015). Outside the topic of Mandarin tone representations, the PI and Co-I are highly experienced with electrophysiological research in general, having multiple publications and presentations in this area (e.g., Bovolenta, Politzer-Ahles, & Husband, 2016; Fiorentino, Politzer-Ahles, et al., 2015; Hunt, Politzer-Ahles, et al., 2013; Nieuwland et al., 2018; Politzer-Ahles, 2015; Politzer-Ahles et al., 2013, 2017, 2019; Politzer-Ahles & Gwilliams, 2015; Tucker, Politzer-Ahles, et al., 2014) and extensive involvement in the EEGLAB and Fieldtrip open-source software communities for EEG data analysis. Thus, between extensive experience in conducting mismatch negativity experiments (particularly, experiments using the sort of paradigm that will be used in the proposed study) and being situated in a department with an EEG laboratory, the team is well equipped to carry out this line of research.

MOTIVATION

As described above, there is currently no unambiguous evidence that mismatch negativity can be elicited by completely abstract contrasts without physical correlates. The present study will test whether the mismatch negativity can be evoked without any physical correlate, in order to better understand the mechanisms that support this neural change detection process. If this turns out to be the case, it would provide the strongest evidence yet that the MMN is a function of abstract categorization, beyond stimulus modality and physical features; the study will also build upon this finding by testing which kinds of abstract categorization the MMN is sensitive to. On the other hand, if an MMN cannot be elicited by such contrasts, this would refine our understanding of the MMN by limiting the scope of what processes the MMN reflects.

RESEARCH PLAN AND METHODOLOGY

The present proposal encompasses two sets of experiments. Experiments 1a and 1b will use irregular morphology to test whether a mismatch negativity can be elicited by a contrast between past-tense and present-tense verbs with no physical correlate of the tense difference; this would provide the strongest test of a fully abstract mismatch negativity. To further narrow down what kinds of abstract categorization (if any) are reflected by the MMN, Experiments 2a and 2b will use the same design, but with a semantic contrast. As lack of MMN in the present study is potentially just as informative as an MMN would be, we take steps in our design to make it possible to make conclusions even from null results: we design our experiments with as high power as feasible (by planning for much larger samples than normal), have built-in replications,

and allow for manipulation checks to be included.

Note that Experiments 1a-b are about categorization and the MMN, not about morphology per se. Morphological and semantic violations are often assumed to elicit later ERP components, like anterior negativities or the N400; these, however, are not relevant for the present research. N400 is elicited when a stimulus is difficult to semantically access, usually because it is rare, unexpected or incongruent with the context; left anterior negativities implicated in morphological processing generally occur when a morphosyntactic rule is violated (either within words or in phrase-level dependencies). The present study is not testing either of those sorts of paradigms. Rather, the present study is only focused on whether the MMN can be elicited when stimuli can be organized into standard and deviant categories based on non-physical cues; irregular morphology merely provides one way to create such categories, but is not in of itself the focus of the study. Thus, we do not expect to observe ERP components specific to morphological or semantic processing (indeed, the notion that there are "morphological" or "semantic" ERP components is outdated; ERP components reflect operations, not linguistic subfields). We expect to observe ERP components related to the detection of deviation from an established category or rule, and thus we expect to observe the MMN.

Each experiment in the present project will be pre-registered through the Open Science Foundation (http://osf.io) prior to the commencement of data collection. Materials, data, and replicable analysis code will be published alongside any articles deriving from this project, and these will be listed at the "Directory of publicly available datasets from psycholinguistic studies" (Malsburg, https://git.io/fAUI6). The results will be disseminated in one or more of the major journals in phonetics and neurolinguistics, with an aim to support journals that are high-impact but also engaged in open science (i.e., journals that include registered reports and open access publishing). Each experiment is expected to require about 10 months; an additional 4 months is built into the project to allow time for writing-up after the experiments are completed.

Experiments 1a-b: Mismatch negativity for an abstract morphological contrast (10 months)
Aim: To examine whether mismatch negativity can be elicited by a morphological contrast with no physical correlate.

Design and predictions: 96 native speakers of American English will be recruited per experiment at the Hong Kong Polytechnic University and University of Minnesota. (Power analysis [https://politzerahles.shinyapps.io/ERPpowersim/] suggests that N=96 will give approximately 80% power to statistically detect a −0.75 μV effect, slightly smaller than that observed in Politzer-Ahles et al., 2016.) If necessary, we also have the potential to recruit participants at the University of Kansas, where the PI has collaborators. While watching a silent movie with subtitles, participants will hear four blocks of sounds each presented in a mismatch negativity oddball design. Two blocks will use words as stimuli and two will use bare vowels (see also Table 1). Of the blocks with word stimuli, one block comprises past-tense verbs {*gave*, *won*, *lit*} as deviants and present-tense verbs {*pave*, *run*, *sit*} (as well as 15 other present-tense verbs) as standards; the other block has the present-tense verbs as deviants and the past-tense verbs (along with 15 other past-tense verbs) as standards. The reason for including extra past- or present-tense standard verbs in each block is so that participants cannot realize a standard-deviant contrast simply by noticing that some particular verbs, like *gave*, are being presented less frequently than others; rather, every verb will be presented the same number of times in a block, but a given abstract category of verbs (past or present) will be presented frequently or

infrequently relative to the other category. Examples are shown below (letters in [] brackets are International Phonetic Alphabet notations):

Word block, past-tense deviant: *pave feed tear fall fight* ***gave*** *run sit get write* ***won****…*
Word block, present-tense deviant: *gave fed tore fell fought* ***pave*** *won lit got wrote* ***run****…*
Vowel block, past-vowel deviant: [ɛɪ] [i] [ɛ] [ɔ] [ʌɪ] **[ɛɪ]** [ʌ] [ɪ] [ɛ] [ʌɪ] **[ʌ]**…
Vowel block, present-vowel deviant: [ɛɪ] [ɛ] [ɔ] [ɛ] [ɔ] **[ɛɪ]** [ʌ] [ɪ] [a] [oʊ] **[ʌ]**…

The other two blocks, i.e., the vowel blocks, simply consist of the vowels excised from each word in the word blocks. They serve as a control condition. The verbs in the word blocks were chosen such that past and present-tense critical words have the same vowels and thus cannot be uniquely grouped into categories based on their acoustic correlates (e.g., the past-tense verb *gave* and the present-tense verb *pave* both have the same vowel, the diphthong [ɛɪ]); however, it is possible that participants might detect some low-level difference between past- and present-tense verbs that we have not considered. The control block can rule this out. If a mismatch negativity observed in the word blocks is just due to low-level cues rather than to the abstract morphological difference between past- and present-tense verbs, there should not be a mismatch negativity in the vowel control blocks.

In each block, each word or vowel will be repeated 80 times in random order, such that each block consists of 1680 trials (80 each for the three critical deviants, three critical standards, and 15 extra standards) plus one repetition of each standard at the beginning of the trial for participants to become acclimatized to the standards; the procedure will take approximately two hours, plus half an hour for briefing the participant and for setup. Stimuli will be recorded from a native speaker of American English and intensity-normalized using Praat (Boersma & Weenink, 2016). Disambiguation points for each word and vowel will be measured using a separate gating study with 20 participants, and these disambiguation points will be used for time-locking in the event-related potential analysis. Event-related potentials time-locked to each instance of each critical word or vowel will be analyzed; for example, the response elicited by *gave* when it is presented as a deviant will be compared to the response elicited by the exact same word when it is presented as a standard.

The experiment thus follows a 2 (TRIALTYPE: deviant vs. standard) × 2 (DEVIANTTENSE: past tense vs. present tense) × 2 (BLOCKTYPE: word vs. vowel) design. If mismatch negativity is elicited by the abstract contrast, we expect to see a significant TRIALTYPE×BLOCKTYPE interaction, such that deviants elicit more negative brain responses than standards, but only in word blocks, not in vowel blocks. It is also possible that this effect may interact with DEVIANTTENSE (e.g., if the mismatch negativity is bigger for past-tense deviants among present-tense standards than vice versa), although this is not the primary focus of our study. Since we have two possible statistical effects that could support our hypothesis, the alpha level will be set to .025 [for two comparisons], with one-tailed tests used for the TRIALTYPE×BLOCKTYPE interaction for which we have a specific directional prediction, and two-tailed tests for the TRIALTYPE×BLOCKTYPE×DEVIANTTENSE interaction. Statistics will be conducted using cluster-based permutation tests (Maris & Oostenveld, 2007) focusing on a 100-500 millisecond time window (given the *a priori* prediction that effects will be less focal than typical mismatch negativities, as observed in Politzer-Ahles et al., 2016) and on fronto-central electrodes. A wide analysis window will be chosen based on the fact that the present paradigm is fairly novel and thus it is possible that the mismatch negativity may occur later than often seen in other

paradigms. Furthermore, note that we are using cluster-based permutation tests over this window, not actually averaging the waveforms in this whole window; a cluster-based permutation test over this large window can still detect short-lived effects that only occur in a small portion of the window.

A limitation of the experiment is that it does not include a manipulation check (i.e., a simple contrast to confirm that simple, typical mismatch negativities can be elicited in our sample of participants and with our lab setup). However, because the experiment is already very long (with the number of stimuli and blocks currently planned, it is estimated to take close to two hours, and power analysis suggests that reducing the number of stimuli may substantially limit power), we have opted instead to maximize the chance of finding a mismatch negativity and avoid adding more conditions, rather than add manipulation checks which may increase participants' fatigue and reduce the power for observing effects in the comparison of greatest theoretical interest. If an MMN is not observed in Experiment 1a, a manipulation check may be added in Experiment 1b, because a null effect in two experiments will be more interpretable if a manipulation check is also present to demonstrate that the experimental setup was able to detect MMNs.

Experiment 1b will be a conceptual replication of Experiment 1a with a different set of verbs. Because this mismatch negativity paradigm tests only a small number of items, unlike other psycholinguistic designs which allow for many items, it is important to re-test such a mismatch design on a new set of items to increase confidence that the effect is generalizable.

Experiments 2a-b: Mismatch negativity for an abstract semantic contrast (10 months)
Aim: Experiments 1a-b focus on a morphological contrast. If an MMN is observed for this contrast, it will raise the question of whether any other types of abstract information are pre-attentively categorized. If an MMN is not observed, it will likewise raise the question of whether 'abstract' MMNs could have been observed for something other than a morphological contrast. Therefore, Experiments 2a-b will extend the design by focusing on a semantic contrast which, like the morphological contrasts tested in Experiments 1a-b, is not signaled by any reliable physical cue.

Design and predictions: 96 participants will be sampled from the same population as in Experiment 1. The experiment design is the same as Experiments 1a-b, except that the standards and deviants are distinguished by semantic category membership rather than morphological class. For example, while Experiment 1a contrasts past-tense and present-tense verb forms, Experiment 2a will contrast animal-related and tool-related words. As in Experiments 1a-b, we will test whether an MMN is realized in the blocks contrasting words from different semantic categories, and not in vowel control blocks.

SUMMARY AND IMPACTS
In this two-year project, we will test both broadly and deeply the ways in which the mismatch negativity, a crucial brain component implicated in language comprehension, may be sensitive to completely abstract contrasts. The findings of this project will inform our understanding of the neural mechanisms that support language comprehension, possibly even changing our understanding of the functional significance of the mismatch negativity. A better understanding of these mechanisms, and of the mismatch negativity in particular, may also facilitate its use for translational and clinical applications, where the mismatch negativity has already shown promise as a biomarker for several conditions (Schall, 2016; Zarza et al., 2007).

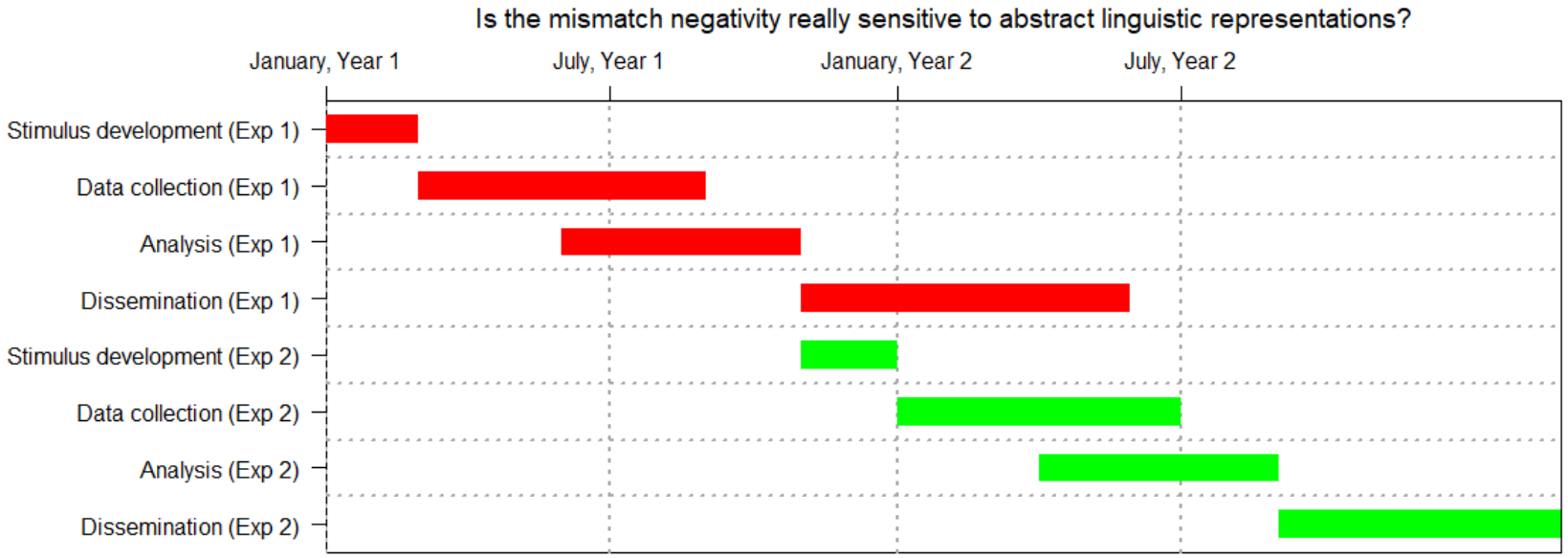
Is the mismatch negativity really sensitive to abstract linguistic representations?
January, Year 1
July, Year 1
January, Year 2
July, Year 2
Stimulus development (Exp 1)
Data collection (Exp 1)
Analysis (Exp 1)
Dissemination (Exp 1)
Stimulus development (Exp 2)
Data collection (Exp 2)
Analysis (Exp 2)
Dissemination (Exp 2)

Table 1. Stimuli and design for Experiment 1a.

	Block Type: **Deviant Tense:**	Word Present	Word Past	Vowel Present vowel	Vowel Past vowel
Critical deviant		**shake**	**gave**	**ɛɪ**	**ɛɪ**
Critical deviant		**run**	**won**	**ʌ**	**ʌ**
Critical deviant		**sit**	**lit**	**ɪ**	**ɪ**
Critical standard		**gave**	**shake**	**ɛɪ**	**ɛɪ**
Critical standard		**won**	**run**	**ʌ**	**ʌ**
Critical standard		**lit**	**sit**	**ɪ**	**ɪ**
Extra standard		fed	feed	ɛ	i
Extra standard		tore	tear	ɔ	ɛ
Extra standard		got	get	a	ɛ
Extra standard		fought	fight	ɔ	ʌɪ
Extra standard		chose	choose	oʊ	u
Extra standard		hid	hide	ɪ	aɪ
Extra standard		took	take	ʊ	ɛɪ
Extra standard		fell	fall	ɛ	ɔ
Extra standard		shot	shoot	a	u
Extra standard		met	meet	ɛ	i
Extra standard		wrote	write	oʊ	ʌɪ
Extra standard		rose	rise	oʊ	aɪ
Extra standard		wore	wear	ɔ	ɛ
Extra standard		rang	ring	æ	ɪ
Extra standard		sang	sing	æ	ɪ

3. Re-submission of a proposal not supported previously

(a) Is this proposal a re-submission or largely similar to a proposal that has been submitted to but not supported by the UGC/RGC or other funding agencies?

Yes ☑ **No** ☐

If yes, please state the funding agency(ies) and the funding programme(s):

RGC GRF

Reference No(s). [for UGC/RGC projects only. For non UGC/RGC projects, please input N.A.]: 15604619

Project title(s) [if different from Section 1(a) of Part I above]:

<not different>

Date(month/year) of application: 11/2018

Outcome: not supported

(b) If this application is the same as or similar to the one(s) submitted but not supported previously, what were the main concerns / suggestions of the reviewers then?

The reviewers and panel felt that the proposed research was not sufficiently different from previous research. Specifically, they felt that Kazanina (2006) already proves the points that our proposal (especially experiments 2a-b of our proposal from last year, focusing on a phonological voicing contrast) aimed to test. The panel stated that our other set of experiments (1a-b, focusing o a morphological contrast) was more novel, and urged us to develop a proposal focusing more on that, and specifically testing what kinds of information are processed pre-attentively.

(c) Please give a brief response to the points mentioned in Section 3(b) above, highlighting the major changes that have been incorporated in this application.

Following the panel's suggestion, we have removed the experiment on phonological voicing (anyway, in the interim between last year's submission and the panel result, another group of researchers already did an identical experiment) and replaced it with an experiment more similar to experiments 1a-b, which the panel suggested us to focus on. Now the proposal tests two kinds of abstract contrast (morphological and semantic) which are different from what was done by Kazanina and colleagues; there is no longer any test of abstract phonological contrasts.

We have also added extra detail to the summary of Kazanina et al. (2006) to further explain why we do not believe their study addresses the same thing as ours. This is in the first paragraph of the "Previous work done by others" section. This may be moot, however, as our study is now explicitly divorced from questions about abstract phonological categories.

R3 had also given a helpful minor suggestion regarding controlling the duration of word-initial fricatives in our proposed study on abstract phonological categories. However, since we have now removed that study, this suggestion has become moot.

R2 had also raised three other points (in addition to the main point about novelty, described above). First of all, R2 expressed concern that our analysis window of 100-500ms was long. Our previous submission already included a parenthetical explaining why we chose this window, but it may have been hard to notice. Now we have added a longer explanation (bottom of p. 6 of the proposal) of why we chose this window. Secondly, R2 stated that there is already research putatitvely showing MMNs for morpho-syntactic violations. Our previous proposal already addressed those studies and explained why we do not consider them evidence for what they claim to be; this discussion remains at the bottom of p. 3 of the proposal, the end of the "Previous work" section. Finally, R2 stated that there is not much research on neural processing of abstract vs. underspecified representations, and encouraged us to do that. Actually, we are some of the few researchers who have done that kind of work already (Schluter, Politzer-Ahles, et al. 2016 compares the neural processing of underspecified versus un-specified features). While we of course agree that examining different kinds of abstraction and underspecification are important (we've already published papers discussing that), that is not the focus of this study, and we feel it is more valuable to judge the proposal on its own merits rather than on what other things we could have chosen to study instead.

PROJECT FUNDING

4. Cost and Justification

(a) Estimated Cost and Justification:

[Detailed justifications should be given in order to support the request for each item below]

(a maximum of 500 words for each box)

	Year 1 ($)	Year 2 ($)	Year 3 ($)	Year 4 ($)	Year 5 ($)	Total ($)
(A) One-line Vote Items						
(i) Supporting Staff Costs						
[please read Section 4(a)(A)(i) of the Explanatory Notes GRF2 carefully]						
Types						
Monthly salary x Nos. x Months						
Research Assistant						$744,660
17,640 * 2 * 12	423,360					
17,850 * 2 * 9		321,300				

Justification:

Two Research Assistants/Associates will be recruited for this project. This project is labor-intensive, including an estimated 420 ERP sessions (4 experiments with N=105 each [we aim for 96 per experiment, but it is always expected that there will be some attrition]), each of which may take around 3 hours. Research Assistants/Associates who are well versed in running behavioral and ERP experiments with human subjects and in analyzing ERP data is indispensable for the timely completion of all experiments in this project. The duties of the Research Assistants/Associates include recruiting participants, running ERP experiments, analyzing ERP data under the supervision of the PI, and assisting as needed with preparing publications based on the data collected. The Research Assistants would also be trained by the PI in how to run ERP experiments (unless they already have this experience). Each research assistant is employed for 12 months in the first year, earning a salary plus 5% contribution to MPF; we budget for annual salary increases in case the same research assistant stays on the project. In the second year, we budget for one RA to work 12 months and one 6 months, or for both RAs to work 9 months, as we expect that the bulk of the data collection (as well as other

time-consuming activities like stimulus preparation and testing the experiment protocol) will take place in Year 1. Because The Hong Kong Polytechnic University has an active group of researchers in neurolinguistics using EEG, there are many students and research assistants available who have previous research experience in EEG data acquisition; however, if no qualified candidates emerge, the funds may be used instead to hire a single post-doctoral associate instead of two research assistants.

(ii) Equipment Expenses
[please itemize and provide quotations for each item costing over $200,000]

Justification:

Quotation Provided: **Yes** ☐ **No** ☑

(iii) Outsourcing Expenses of Research Work Outside Hong Kong
[please itemize your cost estimation with justification and provide quotations for work costing over $200,000; and provide detailed justification of sample sizes and costs for surveys conducted outside Hong Kong.]

Justification:

Quotation Provided: **Yes** ☐ **No** ☑

(iv) General Expenses
[please itemize and provide quotations for services/purchase costing over $200,000; and provide detailed justification of sample sizes and costs for surveys conducted in Hong Kong.]

Participant fees, EEG consumables, and open-access publishing fees. See Justification.	100,700	100,700	0	0	0	201,400

Justification:

FIRST YEAR: 210 participants will participate in EEG experiments (the goal is N=96 for each of Experiment 1a and Experiment 1b, but I budget for several extra participants in case some participants need to be excluded because of data artifacts). Each participant will receive $250 compensation (about 3 hours) plus reimbursement for travel expenses up to $50 (Total: ($250+$50)*210 = $63,000).
EEG consumables:

- Quik-Gel Electrolyte (128oz-bottles). One $700 bottle is typically enough for at least 10 participants, so we budget for 21*700 = $14,700.
- Disposable ear buds for auditory stimulation: $480 for a bag of 50, 420 are needed (210 participants times 2 ears), meaning 9 bags, so we budget for 9*480=$4320
- Enviricide disinfectant: $800 for a gallon bottle
- NuPrep abrasive cream: $320 for 12 oz, which is generally enough for at least 60 participants in my previous studies; so we budget for 4*320 = $1280.
- Other consumables (things easily bought at a pharmacy like gauze, alcohol wipes, and medical tape): $1000

Open-access publishing fees (estimated based on the typical fee of discipline-relevant PLoS journals, Frontiers journals, and Collabra): $14,000

SECOND YEAR: Same as Year 1

Quotation Provided: **Yes** ☐ **No** ☑

(v) Conference Expenses

Standard conference expenses for dissemination at international conferences.	20,000	20,000	0	0	0	40,000

Justification:

Standard conference expenses for dissemination at international conferences.

Sub-total for (A) (One-line Vote Items): **$** 986,060

(B) Earmarked Items

(vi) Costs for Employment of Relief Teacher

[see Enclosure III for individual research and Enclosure V for relief support under Humanities and Social Scienecs Panel]

Rank

Per course rate of relief teacher: x No. of course to be relieved

Justification:

Current Average Teaching Load: Total 0 courses per academic year [please report UGC-funded programmes only]

(vii) Expenses of Research Experience for Undergraduate Student
(see Enclosure VI for Provision of Research Experience for Undergraduate Students)

			$25,000
2,500 * 1 * 5	12,500		
2,500 * 1 * 5		12,500	

Justification:

Training and education for undergraduate students.

(viii) High-performance Computing Services Expenses

Justification:

Quotation Provided: **Yes** ☐ **No** ☑

(ix) Research-related Software Licence /Dataset
[Please itemize and provide quotations for each item]

Presentation	3,500	3,500	0	0	0	7,000

(Neurobehavioral Systems) software license: $3,500 per year (one-year license fee is 440 USD, per neurobs.com)

Justification:

Presentation is a widely used experiment control software for administering experiments in psychology and neuroscience, and interfaces well with EEG acquisition systems. The PI and Co-I have used this software in all of their published EEG experiments.

Sub-total for (B) (Earmarked Items):	**$**	32,000
(x) Total cost of the project (A) + (B)	**$**	1,018,060

(C) Deduction Items

Less :

(xi) University's funding for provision of research experience for undergraduate student	**$**	12,500
(xii) Other research funds secured from other sources	**$**	0
Sub-total for C (Deduction Items):	**$**	12,500
(xiii) Amount requested in this application : (A) + (B) - (C)	**$**	1,005,560

(D) Academic Research related to Public Policy Developments

(xiv) Percentage of the total cost of the proposal related to public policy developments ((A) + (B))
[see Enclosure VII for Support for Academic Research relating to Public Policy Developments] 0%

(b) Declaration on the Equipment Procurement:

☑ **(i) No procurement of equipment is required**

OR

☐ **(ii) I declare that the equipment indicated in 4(a)(A)(ii) above is not available in the university**

OR

☐ (iii) I declare that all or some of the equipment (please provide details in the following text box) indicated in Section 4(a)(A)(ii) above is available in the university but cannot be used by me in view of the following reasons (a maximum of 500 words)

Reasons : (a maximum of 500 words)

(c) Declaration on employment of relief teacher:

☑ (i) No relief teacher is required

OR

☐ (ii) I declare that I currently do not hold any grant for employment of relief teacher of any on-going project under UGC/RGC funding schemes

OR

☐ (iii) I declare that I hold grant for employment of relief teacher of the following on-going project(s) under UGC/RGC funding schemes (excluding Humanities and Social Sciences Prestigious Fellowship Scheme (HSSPFS)) and undertake to submit the corresponding completion report(s) by 15 April 2020

(d) Declaration on high-performance computing services:

☑ (i) No procurement of high-performance computing services is required

OR

☐ (ii) I declare that the high-performance computing services indicated in Section 4(a)(B)(viii) above is not available in the university

OR

☐ (iii) I declare that all or some of the high-performance computing services (please provide details in the following text box) indicated in Section 4(a)(B)(viii) above is available in the university but

cannot be used by me in view of the following reasons(a maximum of 500 words)

Reasons : (a maximum of 500 words)

(e) Declaration on the research-related software licence / dataset:

☐ **(i) No procurement of research-related software licence / dataset is required**

OR

☐ **(ii) I declare that the research-related software licence / dataset indicated in Section 4(a)(B)(ix) above is not available in the university**

OR

☑ **(iii) I declare that all or some of the research-related software licence / dataset (please provide details in the following text box) indicated in Section 4(a)(B)(ix) above is available in the university but cannot be used by me in view of the following reasons (a maximum of 500 words)**

Reasons : (a maximum of 500 words)

This software works on an annual license. Currently the lab shared by members of the Department of Chinese and Bilingual Studies has a license for this, but there is no guarantee that they will still have funds to renew the license two or three years later (when this study is going on). Therefore, it is necessary for the project to have its own funding allocated for this.

5. Existing facilities and major equipment available for this research project: (a maximum of 400 words)

Department of Chinese and Bilingual Studies has a fully equipped EEG laboratory with a 128-channel Neuroscan Synamps amplifier, three 64-channel QuikCaps, an RF-shielded and sound-proofed booth, and software licenses for Neuroscan CURRY for data acquisition and STIM, E-Prime, and Presentation for experiment control. The department also has a departmental license for MATLAB (and the lab also has three standalone MATLAB licenses), which is what will be used for data preprocessing and statistical analysis.

6. Funds secured or to be secured

(a) Other research funds already secured for this research proposal:
[This amount will be deducted from the total cost of the project in Section 4 of Part II above.]

Source	Amount ($)

(b) Other research funds to be or are being sought for this research proposal.
[If funds under this item are secured, the amount of the GRF to be awarded may be reduced]:

Source	Amount ($)

7. Particulars of PI and Co-Is

(a) Investigator(s) information:
Name and Academic Affiliation of Applicant:

	Name	Post	Unit/ Department/ University	ORCID iD	Current Member of UGC / RGC / Panel / Committee as at application deadline (Yes or No)	Name of UGC / RGC / Panel / Committee
PI	Dr POLITZER-AHLES, Stephen	Assistant Professor	Department of Chinese and Bilingual Studies/The Hong Kong Polytechnic University	0000-0002-5474-7930	No	
Co-I(s)	Dr Schluter, Kevin		unaffiliated		No	

(b) Curriculum vitae (CV) of Applicant(s).

[For the PI and each Co-I, please attach a CV (a maximum of two A4 pages in standard RGC format for attaching PDF documents or a maximum of 800 words for direct input in the text box) per person in the following format.]

i) Name:

ii) Academic qualifications:

iii) Previous academic positions held(with dates):

iv) Present academic position:

v) Previous relevant research work:

vi) Publication records [Please refer to GRF 2 Part II Section 7 for the format required by the RGC]:

Section A - Five most representative publications in recent five years

Section B - Five representative publications beyond the recent five-year period with the latest publication entered first.

vii) Others (please specify):

(c) Plan(s) for collaboration in this application:

[Indicate the role and the specific task(s) the PI and each Co-I , if any, is responsible for.]

[Letter(s) of collaboration should be attached]

The PI will be involved in all stages of the project [part (2)(b)(ii)]: designing the experiments, creating experimental stimuli (with assistance from Research Assistants), overseeing data collection (with assistance from Research Assistants), analyzing the data, presenting it at conferences and writing up the results for publication (together with the Co-I and Research Assistants). The Co-I will assist in an advisory capacity with designing the experiments and with overseeing additional data collection if necessary.

☑ **I confirm that the Co-I(s) listed in the proposal have explicitly agreed to serve in the project team and a copy of the proposal has been provided to each of the Co-Is. Letter(s) of collaboration from the Co-I(s) is/are attached. I shall provide further documentary proof on the collaboration upon the request of the RGC / Secretariat.**

(d) Number of hours per week to be spent by the PI in the proposal: 10 hour(s)

Stephen Politzer-Ahles

ACADEMIC QUALIFICATIONS

2013 Ph.D, Linguistics, University of Kansas
2011 M.A., Linguistics, University of Kansas
2008 B.A., Modern Languages and Literatures, Kenyon College

PREVIOUS ACADEMIC POSITIONS HELD

2015-2016 **Post-doctoral associate**, The University of Oxford. Faculty of Linguistics, Philology and Phonetics.
2013-2015 **Post-doctoral associate**, New York University Abu Dhabi. NYUAD Institute.

PRESENT POSITION

2016- **Assistant Professor**, The Hong Kong Polytechnic University. Department of Chinese and Bilingual Studies.

PREVIOUS RELEVANT RESEARCH WORK

Running mismatch negativity experiments in China, the United Arab Emirates, and Hong Kong; running EEG experiments in the United States, China, the United Arab Emirates, the United Kingdom, and Hong Kong; supervising research staff (RAs and post-doc) in Hong Kong

TEN REPRESENTATIVE PEER-REVIEWED PUBLICATIONS

2018 **Politzer-Ahles, S.**, & Piccinini, P. On visualizing phonetic data from repeated measures experiments with multiple random effects. *Journal of Phonetics, 70*, 56-69. (Author 1 of 2).

2018 Nieuwland, M., **Politzer-Ahles, S.**, Segaert, K., Darley, E., Kazanina, N., Von Grebmer Zu Wolfsthurn, S., …, & Huettig, F. Large-scale replication study reveals a limit on probabilistic prediction in language comprehension. *eLife, 7*, e33468. (Author 2 of 22).

2017 Schluter, K., **Politzer-Ahles, S.**, Al-Kaabi, M., & Almeida, D. Laryngeal features are phonetically abstract: mismatch negativity evidence from Arabic, English, and Russian. *Frontiers in Psychology – Language Sciences, 8*, 746. (Author 2 of 4).

2017 **Politzer-Ahles, S.**, Xiang, M., & Almeida, D. "Before" and "after": investigating the relationship between temporal connectives and chronological ordering using event-related potentials. *PLoS ONE, 12*, e0175199. (Author 1 of 3)

2016 **Politzer-Ahles, Stephen**; Schluter, Kevin; Wu, Kefei; & Almeida, Diogo. Asymmetries in the perception of Mandarin tones: evidence from mismatch negativity. *Journal of Experimental Psychology: Human Perception and Performance, 42*, 1547-1570. (Author 1 of 4)

2016 Schluter, Kevin; **Politzer-Ahles, Stephen**; & Almeida, Diogo. No place for /h/: ERP investigation of English fricative place features. *Language, Cognition, and Neuroscience, 31*, 728-740. (Author 2 of 3)

2015 Fiorentino, Robert; **Politzer-Ahles, Stephen**; Pak, Natalie; Martínez-García, María Teresa; & Coughlin, Caitlin. Probing the dynamics of complex word

recognition: An ERP Investigation of the processing of novel compounds. *The Mental Lexicon, 10*, 413-434. (Author 2 of 5)

2015 **Politzer-Ahles, Stephen**; & Gwilliams, Laura. Involvement of prefrontal cortex in scalar implicatures: evidence from magnetoencephalography. *Language, Cognition, and Neuroscience, 30*, 853-866. (Author 1 of 2)

2013 Hunt, Lamar; **Politzer-Ahles, Stephen**; Gibson, Linzi; Minai, Utako; & Fiorentino, Robert. Pragmatic inferences modulate N400 during sentence comprehension: evidence from picture-sentence verification. *Neuroscience Letters, 534*, 246-251. (Author 2 of 5)

2013 **Politzer-Ahles, Stephen**; Fiorentino, Robert; Jiang, Xiaoming; & Zhou, Xiaolin. Distinct neural correlates for pragmatic and semantic meaning processing: An event-related potential investigation of scalar implicature processing using picture-sentence verification. *Brain Research, 1490*, 134-152. (Author 1 of 4)

RESEARCH-RELATED AWARDS

2013 One-University Open Access Publishing Fund, University of Kansas
2013 CUNY Travel Award, CUNY Conference on Human Sentence Processing
2012 Doctoral Student Research Fund, University of Kansas
2012 IPA Student Award, International Phonetic Association
2011-2012 France Ingemann Scholarship, Linguistics Department – University of Kansas
2009 Linguistics Honors Fellowship, Linguistics Department – University of Kansas
2008-2009 Graduate Studies Scholarship, University of Kansas

CONSULTANCY

2017 Invited workshop on ERP experiment design and data analysis [Shandong University of Finance and Economics], 30 May – 2 June
2016 Invited workshop on mixed-effects modeling in R [Linguistics, University College London], 18-20 May

GRANT REFEREEING

National Science Foundation (Linguistics panel); *Swiss National Science Foundation*; *FWO – Flanders*; *Research Grants Council (Hong Kong)*

JOURNAL REFEREEING

Biling: Lang Cog; *Brain Lang*; *Cognition*; *Cog Aff Behav Nsci*; *Cog Psych*; *Dev Cog Nsci*; *Dev Neuropsych*; *Dev Sci*; *Frontiers Psych*; *Frontiers Nsci*; *JASA Expr Lett*; *J Mem Lang*; *Lang Speech*; *Lang Cog Nsci*; *Neuropsych*; *Psychonom Bull Rev*; *Q J Exp Psych*

EXTRAMURAL GRANTS

2018-2020 Early Career Scheme #25606117, Research Grants Council (Hong Kong), "Mental representations of Chinese tones: abstract vs. episodic accounts". 742,856 HKD

2010 East Asia & Pacific Summer Institutes #1015160, National Science Foundation, “An ERP investigation of the processing of visually-presented Mandarin sentences”

Kevin Thomas Schluter

ACADEMIC QUALIFICATIONS

2013 Ph.D, Linguistics, University of Arizona
2011 M.A., Linguistics, University of Arizona
2008 M.A., Linguistics, University of Minnesota
2004 B.A., Religious Studies and Classical & Near Eastern Archaeology, University of Minnesota

ACADEMIC POSITIONS

2018-2019 **Lecturer**, University of Minnesota. Linguistics.
2013-2017 **Post-doctoral associate**, New York University Abu Dhabi. Division of Psychology.

PREVIOUS RELEVANT RESEARCH WORK

Running mismatch negativity experiments in the United Arab Emirates, running behavioral experiments online (via Mechanical Turk) and in the field (Morocco), managing research staff (University of Arizona).

REPRESENTATIVE PEER-REVIEWED PUBLICATIONS

2017 **Schluter, K**., Politzer-Ahles, S., Al-Kaabi, M., & Almeida, D. Laryngeal features are phonetically abstract: mismatch negativity evidence from Arabic, English, and Russian. *Frontiers in Psychology – Language Sciences*, *8*, 746. (Author 1 of 4).

2016 Politzer-Ahles, Stephen; **Schluter, Kevin;** Wu, Kefei; & Almeida, Diogo. Asymmetries in the perception of Mandarin tones: evidence from mismatch negativity. *Journal of Experimental Psychology: Human Perception and Performance, 42*, 1547-1570. (Author 2 of 4)

2016 **Schluter, K;** Politzer-Ahles, S; & Almeida, D. No place for /h/: ERP investigation of English fricative place features. *Language, Cognition, and Neuroscience, 31*, 728-740. (Author 1 of 3)

2015 Ussishkin, A; Dawson, C; Wedel, A; and **Schluter, K**. Auditory masked priming in Maltese spoken word recognition 30, 1096-1115. *Language and Cognitive Neuroscience.* (Author 4 of 4).

RESEARCH-RELATED AWARDS

2013 College of Social and Behavioral Sciences Dissertation Completion Fellowship.
2009-2013 Graduate and Professional Student Committee Travel Grants. (4)
2011-2012 American Institute of Maghrebi Studies Fellowship.
2009-2012 Social and Behavioral Sciences Research Institute Small Grants. (4)
2011 Linguistic Society of America Summer Institute Fellowship.
2006-2010 USDE Foreign Languages and Area Studies Fellowships (4)
2009 Magellan Circle Grant.
2007 University of Minnesota GAPSA Travel Grant.
2007 CIC Foreign Language Enhancement Program.

GRANT REFEREEING

National Science Foundation (Linguistics panel); University of Arizona Graduate and Professional Student Committee travel grants

JOURNAL REFEREEING

Frontiers in Psychology: Language Science; Phonology; Journal of Experimental Psychology: Learning, Memory, and Cognition

EXTRAMURAL GRANTS

2011-2012 American Institute of Maghrebi Studies Fellowship. *The Root and Pattern in Moroccan Darija: The mental organization of words for speakers of Moroccan Arabic.*

DECLARATION OF RELATED PROPOSALS & GRANT RECORD

[Please refer to GRF2 for information required and implications for non-disclosure of related research work]

[If you have difficulty in making the declaration, please explain.] Please add a new table for each project/proposal.

8. Grant Record and Related Research Work of Investigator(s)

(a) PI - Details of research work undertaken and proposals submitted by the PI (in a PI/PC or Co-I/Co-PI capacity) including:

(i)completed research work funded from all sources (irrespective of whether from UGC/RGC) in the past five years;

(ii)on-going research work funded from all sources (irrespective of whether from UGC/RGC);

(iii)proposals pending funding approval (irrespective of whether submitted to UGC/RGC);

(iv)any related research work that is being / has been conducted in relation to the proposal (irrespective of whether from UGC / RGC and not limited to the past five years), including but not limited to data collection, preliminary research, working papers, publications (such as journal papers, conference papers and books, etc.), presentations, media interviews and other submitted proposals, etc. Please provide the details of the related research work (such as the title of the projects and / or papers / publications, or a brief description of the preliminary research work, etc.) whether or not such work was part of a funded project; and provide clarifications that distinguish that related research work from the work requested to be funded through this proposal. Any researcher who fails to disclose any related research work that is being / has been conducted in relation to the proposal will be subject to disciplinary action.

On-going

1826547 Role:Co-I 15 Sep 18 - 28 Feb 22 Non RGC/UGC Funding

Funding Source(s) (Amount): National Science Foundation (United States)($3,549,213)

Project / Work Title:

Neural mechanisms for phonological alternation with high and low productivity - a case study on Chinese tone sandhi

Project / Work Objective:

Studying the neural mechanisms of the production of Chinese tone sandhi

No. of Hours Per Week Spent by the PI *: 0

Related to the current application: N.A.

25606117 Role:PI 01 Jan 18 - 31 Dec 20 RGC/UGC Funding

Funding Source(s) (Amount): ECS($692,856)

Project / Work Title:

Mental representations of Chinese tones: abstract vs. episodic accounts

Project / Work Objective:

1. To test whether lexical representations of tone are abstract or episodic
   - Experiments 1a & 1b: Using Mismatch Negativity to examine if sandhi accidental gaps [see Background of Research] behave like nonwords (suggesting abstract representation) or words (suggesting episodic representation)
   - Experiments 2a, 2b, & 3: Using Mismatch Negativity and N400 to test whether allomorph surface frequency is lexically represented or not
2. To extend theories of Indo-European languages' mental representation into Chinese tones
3. To establish benchmarks for how these phenomena work in Mandarin, informing future research in other tone systems

No. of Hours Per Week Spent by the PI *: 0

Related to the current application: N.A.

Pending

Role:PI - Non RGC/UGC Funding

Funding Source(s) (Amount): RFS investigator-initiated health and medical fund($1,135,550)

Project / Work Title:

How Autism Spectrum Disorder affects auditory and linguistic processing in Cantonese speakers

Project / Work Objective:

Studying basic auditory processing in people with and without Autism Spectrum Disorder. This study uses the MMN (in one experiment), but the aims and methods are unrelated to those of the present proposal.

No. of Hours Per Week Spent by the PI *: 5

Related to the current application: N.A.

*** The PI is not required to report on the time spent in the capacity of Co-I in GRF / Joint Research Schemes projects.**

(b) Co-I(s) – Details of

(i)on-going research work funded from all sources (irrespective of whether from UGC/RGC) undertaken by each Co-I (in a PI/PC capacity);

(ii)proposals pending funding approval (in a PI/PC capacity).

(iii)any related research work that is being / has been conducted in relation to the proposal (irrespective of whether from UGC / RGC and not limited to the past five years), including but not limited to data collection, preliminary research, working papers, publications (such as journal papers, conference papers and books, etc.), presentations, media interviews and other submitted proposals, etc. Please provide the details of the

related research work (such as the title of the projects and / or papers / publications, or a brief description of the preliminary research work, etc.) whether or not such work was part of a funded project; and provide clarifications that distinguish that related research work from the work requested to be funded through this proposal.Any researcher who fails to disclose any related research work that is being / has been conducted in relation to the proposal will be subject to disciplinary action.

Major research output of previously funded projects

(For applications of Humanities and Social Sciences Panel only)

Major research output of previously funded projects (UGC/RGC and non-UGC/RGC sources) in descending chronological order, undertaken by the PI and each Co-I relevant to this application.

[Provide a summary (a maximum of 400 words in total) on the progress/ publications/ conferences/ student-training, etc. of the projects, with the relevant project reference no.]

Nil

ANCILLARY INFORMATION

9. Research Ethics / Safety Approval and Access to Data / Records

[Please refer to GRF2 Part II Section 9 for the responsibilities and implications]

(a) Research Ethics/Safety Approval

(i) I confirm that the research proposal ☑ **involves /** ☐ **does not involve human subjects.**

(ii) Please tick the appropriate boxes to confirm if approval for the respective ethics and/or safety issues is required and has been / is being obtained from the PI's university. PIs are encouraged to seek necessary approval (except for human research ethics (clinical)) before application deadline as far as possible

	Approval not required	Approval being sought	Approval obtained
(1) Animal research ethics	☑	☐	☐

(2) Biological safety	☑	☐	☐
(3) Ionizing radiation safety	☑	☐	☐
(4) Non-ionizing radiation safety	☑	☐	☐
(5) Chemical safety	☑	☐	☐
(6) Human research ethics (non clinical)	☐	☐	☑

	Approval not required	Approval being sought	Approval obtained	Approval will be sought if funded
(7) Human research ethics (clinical)	☑	☐	☐	☐

(iii) If approval is required by other authorities, please indicate *below* the names of the authorities and the prospects of obtaining such approval. If not applicable, please put down "N.A.".

N.A.

(b) Access to Government/ Official/ Private Data and Records

(i) Is access to Government / official / private data and records critical to the research project?

☐ **Yes**

☑ **No**

If approval is required, please indicate below the names of the agency(ies) of obtaining such approval.

(ii) Please tick in the appropriate boxes to confirm if approval for access to the related data/records has been / is being obtained from the relevant agency(ies). If approval has been obtained, please provide evidence.

List of agency(ies)	Approval not required	Approval being sought	Approval obtained

[Note: PIs are encouraged to seek necessary approval before application deadline as far as possible.]

10. Proposed reviewers

Note from the Secretariat:

At the December 2016 RGC meeting, it was agreed that the practice for applicants to nominate reviewers would be obsolete in view of the availability of RGC's sizable database of external reviewers and easily accessible resources on the internet. The reviewers nominated by the applicants in this exercise would not be adopted.

10. Data Archive Possibilities

(a) Is the proposed project likely to generate data set(s) of retention value?

Yes ☑ **No** ☐

If yes, please describe the nature, quantity and potential use of the data set(s) in future.

All EEG datasets generated in this experiment will be stored indefinitely (at MATLAB .mat files) on a project page hosted at the Open Science Foundation (http://osf.io) and/or GitHub. This will allow the PI and other researchers in the future to use these data for power analyses, follow-up analyses of the present research, meta-analysis, testing new statistical methods, and other things that further the goals of open data / open science.

(b) Are you willing to make the data set(s) available to others for reference twelve months after the publication of research results or the completion of this proposed project?

Yes ☑ **No** ☐

I/We understand that the RGC will release the completion report to the public and only considers data archiving requests after the completion of the RGC-funded project. The RGC has full discretion in funding the archiving requests. Data sets archived with RGC funds will require users to acknowledge the originator and the RGC. The originator will also be provided with copies of all publications derived from the use of the data.

I undertake to include in the project completion report the URL links to the university's repository or the publisher's websites so that the public could have quick and easy access to the manuscripts or journal articles. I will also consider to include in the research completion report the data repository where research data of the project could be accessed and shared, where appropriate.

I undertake that upon acceptance of a paper for publication,

(i) I will check whether the publisher already allows (A) full open access to the publisher's version, or (B) my depositing a copy of the paper (either the publisher's version or the final accepted manuscript after peer-review) in the university's repository for open access;

(ii) if both (i) (A) and (B) are not allowed, I will request the publisher to allow me to place either version in my university's repository for restricted access immediately upon publication or after an embargo period of up to twelve months if required by the publisher; and

(iii) subject to the publisher's agreement on (i) or (ii) above, I will deposit a copy of the publication in my university's repository as early as possible but no later than six months after publication or the embargo period, if any.

11. Education Plan, Technology Transfer Plan, Letters of Collaboration and Supporting Documents

(A maximum of 20 words for each box to caption each uploaded pdf document)

Appendix 1: Education Plan (up to one A4 page)

Letters of Collaboration List:

Dr Schluter, Kevin

EDUCATION PLAN

There are two potential educational components to this project: training the Research Assistant(s) and training possible undergraduate student helpers.

The Research Assistant(s) for this project will most likely be chosen from students who have recently completed a course in Psycholinguistics or Neurolinguistics. The ideal Research Assistant will be an undergraduate student who has expressed an interest in applying for graduate school—in my opinion, training a well-motivated student [who may go on to complete much more research in her future career] is just as important a part of the proposed project as the research itself.

Undergraduate student helpers may also be trained to assist the Research Assistant with data collection. The rate for an undergraduate student helper is $2500 per month. Data collection would not be ongoing constantly throughout the year; rather, I estimate that intensive data collection may last for one term (about 5 months) in a given year.

$2500 per month × 5 months × 2 years = $20,000

October 6, 2019

Dr. Stephen Politzer-Ahles
Department of Chinese and Bilingual Studies
The Hong Kong Polytechnic University
Hung Hom, Kowloon, Hong Kong

Dear Dr. Politzer-Ahles,

I am delighted to serve as Co-Investigator on the project titled “Is the mismatch negativity really sensitive to abstract linguistic representations?” Given our previous collaboration on research using the mismatch negativity, and our discussions about the design of the experiment, I am happy to continue to be involved in the project and dissemination of the results.

As Co-I on this project, I will assist you in designing the experiments, overseeing the administration of the experiments, and interpreting the experimental results.

I look forward to working with you on the project.

Sincerely,

Kevin Thomas Schluter

PART III UNIVERSITY'S ENDORSEMENT AND DECLARATION OF RESEARCH ETHICS/SAFETY

(To be completed by the appropriate authority of the university. The university should confirm that it has evaluated and given support to the application before submission to the RGC.)

UNIVERSITY'S ENDORSEMENT

(* Please tick as appropriate in the boxes)

1. Staff Eligibility Requirement for GRF

I confirm that:

(a) **the application has been evaluated and endorsed by the university for submission to the RGC;**

(b) **the PI, in the staff grade A to I, meets fully the stipulated staff eligibility requirement for and is not debarred from applying for GRF grant;**

[where the PI is newly appointed, the university has formally entered into a contract of service with him/her on or before the submission deadline of this funding exercise and the contract requires him/her to report for duty on or before16 April 2020.]

☑ **the PI is primarily engaged in and spending at least 80% of time in degree or higher degree work at the university; or**

☐ **the PI is / will be seconded to work full-time or part-time at the following Innovation and Technology (I&T) clusters at the Hong Kong Science Park with effect from _____ (mm/yyyy)**

☐ **Health@InnoHK**

☐ **AIR@InnoHK**

(c) ☐ **the PI is/will be employed on permanent term**

☑ **the PI is/will be employed on fixed term contract**

[if the PI is/will be employed on a fixed term contract, the PI has to be still eligible for a GRF grant at the time of funding award being made in June in the following year as well as for at least the first year of the planned project duration.]

(d) ☐ **the PI is/will be a visiting scholar**

☑ the PI is NOT a visiting scholar

[If the PI is a visiting scholar, he/she has to be employed in the university on a full-time basis covering at least one year or the expected project duration whichever is the longer]

(e) the applicant's declared teaching load at Part II Section 4 (a)(B)(vi) has been verified (only for the case where the applicant is seeking funding support for relief teacher);

(f) the applicant will have the number of hours per week as declared in Part II Section 7(d) to supervise the proposed project without prejudice to his / her existing commitment in other research work, teaching and administrative duties;

(g) the university will inform the RGC as soon as the PI ceases to be eligible to apply, receive or hold a GRF grant, and will withdraw the application; or recommend to the RGC for approval of a suitable new PI, if any, to take over the funded project once it is funded and commenced;

(h) the university understands that the GRF grant, if given, will be withdrawn if the project does not start within one year of the announcement of funding. The university should report to the RGC as soon as possible when a PI proceeds on no-pay leave/professional leave for a continuous or cumulative period exceeding 183 days within the project period;

(i) [for PI requesting Employment of Relief Teacher at Part II Section 4(B)(vi) only]

☐ the PI does not currently hold any grant for employment of relief teacher of any on-going project under UGC/RGC funding schemes

☐ the PI holds the grant for employment of relief teacher of the on-going project(s) at Part I Section 1(d) (excluding HSSPFS) and I shall ensure the PI to submit the corresponding completion report(s) by 15 April 2020

UNIVERSITY'S COMMITMENTS

2. Support to PI and Students

I confirmed that:

(a) the university is committed to providing a monthly allowance of $1,250 to the undergraduate student helper up to a maximum period of ten months if this proposal is funded under the provision of research experience for Undergraduate Student (only for the case where the PI has selected this item at Part I Section 1(d))

(b) adequate supervision, research facilities and training provisions

☑ will

☐ will not

be in place to meet the need of RPg student(s) so employed under the research grant if this application is supported by the RGC.

☐ No RPg student will be trained in this proposed project

☐ Not applicable

(c) the research project under this GRF application

☑ is

☐ is not

in line with the role of the university.

(d) ☑ no outsourcing outside Hong Kong is required

☐ the PI's justification at Part II Section 4(a)(A)(iii) is reasonable and I support the PI's application for outsourcing the stated work stated outside Hong Kong

(e) ☑ no equipment is required

☐ the PI's declaration and reasons at Part II Section 4(b) are true and correct and I support the PI's request for this procurement of equipment

(f) ☑ no high-performance computing services is required

☐ the PI's declaration and reasons at Part II Section 4 (d) are true and correct and I support the PIs request for this subscription of high-performance computing resources

(g) ☐ no research-related software licence/dataset is required

☑ the PI's declaration and reasons at Part II Section 4(e) are true and correct and I support the PI's request for this procurement of research-related software licence/dataset

(h) ☑ this application does not include requests for purchasing normal academic

equipment, computer, consumables, postage, fax, stationery, overseas telephone charges, and standard software licence / dataset known to be available or reasonably expected to be provided in the universities concerned.

(i) this application

☑ **has**

☐ **has not (Please provide reasons for not scanning by anti-plagiarism software)**

been scanned by anti-plagiarism software.

3. Research Ethics / Safety Approval and Access to Government/ Official/ Private Data and Records

(a) Research Ethics / Safety Approval

I have examined the research proposal and confirm that:

(i) ☑ **the research proposal involves human subjects**

☑ **and human research ethics (non clinical)**

- ☐ **approval not required / exemption has been obtained.**
- ☐ **approval is being sought.**
- ☐ **exemption is being sought.**
- ☑ **Approval has been obtained.**

☑ **and human research ethics (clinical)**

- ☑ **approval not required.**
- ☐ **approval is being sought.**
- ☐ **approval has been obtained.**
- ☐ **approval will be sought if funded.**

or

☐ **the research proposal does not involve human subjects.**

(ii) the approval of the appropriate authority(ies) is not required or has been/will be obtained in respect of the following :

	Approval not required	Approval being sought	Approval obtained
(1) Animal research ethics	☑	☐	☐
(2) Biological safety	☑	☐	☐
(3) Ionizing radiation safety	☑	☐	☐
(4) Non-ionizing radiation safety	☑	☐	☐
(5) Chemical safety	☑	☐	☐

(b) Access to Government/ Official/ Private Data and Records

I have examined the research proposal and confirm that

(i) the approval of the appropriate authority(ies) is/are:

☐ **Required**

☑ **not required**

(ii) the approval of the appropriate agency(ies) has been/will be obtained in respect of the following :

List of agency(ies)	Approval not required	Approval being sought	Approval obtained

For (a) and (b) above, except human research ethics (clinical), where such approval is required but has not yet been obtained, the university will ensure that it will be obtained without delay. The university understands that if no confirmation of such approval is provided to the RGC by 15 April 2020 , the RGC will regard this GRF application as being withdrawn and will stop further processing it.