

**Post-Migration Living Difficulties and Poor Mental Health
Associated with Increased Interpretation Bias for Threat**

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3 **Post-Migration Living Difficulties and Poor Mental Health Associated with Increased**
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6 **Interpretation Bias for Threat**
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10 Anastasia Vikhanova^{1a}, Dr Marc Tibber², Dr Isabelle Mareschal¹

11
12 ¹ School of Biological and Chemical Sciences, Department of Psychology, Queen Mary
13 University of London, London, UK, E1 4NS
14

15
16 ² Research Department of Clinical, Educational and Health Psychology, UCL, London, UK,
17 WC1E 6DH
18

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20 ^a Corresponding author, a.vikhanova@qmul.ac.uk
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26 **Anastasia Vikhanova:** Conceptualisation, Methodology, Formal Analysis, Investigation,
27 Writing – Original Draft; **Marc Tibber:** Conceptualisation, Writing – Review & Editing,
28 Supervision; **Isabelle Mareschal:** Conceptualisation, Writing – Review & Editing,
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35 **Abstract**
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40 Previous research has found associations between mental health difficulties and interpretation
41 biases, including heightened perception of threat. Building on this research, we explored
42 associations between interpretation biases and three constructs that have been linked to migrant
43 experience: mental health symptoms, post-migration living difficulties (PMLD) and perceived
44 ethnic discrimination. Two hundred and thirty participants who identified as first- ($n = 94$) or
45 second-generation ethnic minority migrant students ($n = 68$), and first-generation White
46 migrant students ($n = 68$) completed measures of mental health, perceived ethnic
47 discrimination, and PMLD. They also performed an interpretation bias task using Point-Light
48 Walkers (PLW), dynamic stimuli with reduced visual input that are easily perceived as humans
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3 performing an action. Five categories of PLW were used: four that clearly depicted human
4 forms undertaking positive, neutral, negative, or ambiguous actions, and a fifth that involved
5 scrambled animations with no clear action or form. Participants were asked to imagine their
6 interaction with the stimuli and rate their friendliness and aggressiveness. We found that poorer
7 mental health and increased PMLD were associated with a heightened threat interpretation of
8 scrambled animations only. There were no differences in friendliness ratings associated with
9 mental health, discrimination or PMLD. These findings have implications for our
10 understanding of the role of threat biases in mental health and the migrant experience.
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24 *Keywords:* biological motion, discrimination, migration, mental health, cognitive biases
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29 sharing their Point Light Walker stimuli with us.
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1 Introduction

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8 Interpretation biases, or the tendency to interpret ambiguous information as negative
9 (threatening) or positive (Beard & Amir, 2008), represent a subset of the wider phenomenon
10 of cognitive biases, which are defined as “cases in which human cognition reliably produces
11 representations that are systematically distorted compared to some aspects of objective reality”
12 (Haselton et al., 2015, p.968). These have been shown to play a key role in the formation and
13 maintenance of many common mental health disorders, including depression (Gotlib et al.,
14 2004), anxiety (Mogg et al., 1992) and Post-Traumatic Stress Disorder (PTSD) (Fani et al.,
15 2012). Studies using ambiguous written or pictorial scenarios, scrambled sentences, or
16 morphed emotional faces have been used to measure interpretation biases within the context of
17 common mental health disorders (Hirsch et al., 2016), and meta-analyses have shown
18 associations between negative interpretation biases and symptoms of depression (Everaert et
19 al., 2017) and social anxiety (Chen et al., 2020) in the medium-to-large effect size range.
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38 However, over 80% of previous research into interpretation biases (and cognitive biases more
39 broadly) has involved the study of samples from Western, Educated, Industrialised, Rich and
40 Democratic (WEIRD) societies, despite these only representing 12% of the world’s population
41 (Henrich, Heine & Norezayan, 2010). More recently, there have been calls to include
42 minoritised groups and widen research to include broader cross-cultural samples including
43 ethnic minorities and migrant groups. One such study that addressed cross-cultural differences
44 in interpretation biases focused on six groups of native and migrant British and Chinese
45 participants in the UK and Hong Kong: native British, native Chinese, long- and short-term
46 migrants to the UK and Hong Kong (Yiend et al., 2019). Participants completed a Scrambled
47 Sentences Task, whereby they were presented with a series of six words, five of which they
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3 needed to re-arrange into a sentence under a high cognitive load (remembering strings of
4 digits). The unused word would represent a positive or negative bias, such as ‘I am a born
5 *winner (or loser)*’ (Wenzlaf & Bates, 1998). The authors found that native British participants
6 made fewer positive interpretations (unscrambled fewer sentences positively) compared to
7 native Asian participants. However, migrating from the UK to Hong Kong led to an increase
8 in these positive interpretations, whereas Chinese migrants to the UK saw a reduction in
9 positive unscrambling of sentences. In other words, migrant participants culturally adapted to
10 biases of the hosting country. It is important to note, though, that the authors did not measure
11 mental health or any other parameters in their study as the focus was to establish a baseline of
12 biases in previously untested migrant populations.
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29 Migrants could be a population of interest in investigating cognitive biases for several reasons.
30 Firstly, migration is commonly associated with an increased risk of developing a range of
31 mental health disorders including anxiety, depression, and post-traumatic stress disorder
32 (PTSD) (Bustamante et al., 2018; Close et al., 2016; Lindert et al., 2009). Commonly, increased
33 levels of mental health disorders in migrants have been attributed to Post-Migration Living
34 Difficulties (PMLDs) (Silove et al., 1997), such as difficulties in meeting basic needs (e.g.
35 permission to work, money, access to benefits), integration issues (e.g. isolation, language
36 problems, missing family) and ethnic discrimination. In turn, ethnic discrimination has been
37 widely linked to mental health difficulties, including generalized and social anxiety (Levine et
38 al., 2014; Rippey & Newman, 2006; Soto et al., 2011) and depression (Alvarez-Galvez & Rojas-
39 Garcia, 2019; Hudson et al., 2016; Noh & Kaspar, 2003) in both migrant and non-migrant
40 groups (Jurado et al., 2017).
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3 Secondly, discrimination might make individuals more prone to perceived threat in their
4 environment. Whilst a bias towards threat may represent an adaptive response to historical
5 experiences of attack or discrimination, when chronically activated it may drive or perpetuate
6 a range of common mental health difficulties, e.g. anxiety (Craske et al., 2011; Shankman et
7 al., 2013). Dovidio (2001) proposed that in the presence of attributionally ambiguous
8 behaviours, such as members of the majority group choosing not to sit next to a minority on a
9 bus, an individual from an ethnic minority is faced with a cognitively demanding task of
10 disambiguation (van den Bos & Lond, 2002), in which they must decide whether this behaviour
11 is driven by racial bias or some other factor (Ozier et al., 2019). Interestingly, motivations and
12 threat perception of majority in this example have been previously explored within a
13 framework of in-group and out-group biases, i.e., favouritism towards members of one's own
14 group and prejudice towards members of the out-group (Brewer, 1979), who are typically
15 perceived as threatening. For example, studies explored White participants' negative attitudes
16 - including enhanced perception of threat - towards ethnic minorities (Riek et al., 2006; Rios
17 et al., 2018), or country citizens' and 'earlier' migrants' discriminatory behaviours towards
18 'new' migrants (Stansfield & Stone, 2018; Van der Zwan, Bles & Lubbers, 2017). However,
19 this framework has never been utilised to investigate how prejudice and discrimination impact
20 on the *minority* group.
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47 Taken together, these findings suggest that under conditions of uncertainty such as during the
48 disambiguation of people's intentions or actions, minority groups may rely on heuristics or
49 cognitive biases, which lead to situations or cues being interpreted as more threatening than
50 they actually are. Further, such biases may be driven by experiences of adversity that are central
51 to many migrant's experiences. However, it remains to be examined whether such an elevation
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3 in interpretation biases and threat perception is associated with increased mental health
4 difficulties, PMLD and the experience of ethnic discrimination.
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10 Much of the previous research into interpretation biases has relied on verbal methodologies,
11 which may be problematic since some participants, especially migrants, may have poorer
12 English skills than native adult speakers (Hirsch et al., 2016). Further, some cognitive biases
13 tasks show low reliability when translated from one language to another (Smith et al., 2018),
14 which further limits current available tools for measuring interpretation biases. One method to
15 study interpretation biases that bypasses the need for verbal fluency is the use of biological
16 motion stimuli or Point Light Walkers (PLW). Originally developed by Johansson (1973),
17 PLW are an array of light dots that represent major joints, the head, and limbs of an actor's
18 body. Previous research has found that although limited in visual information, PLW contain
19 sufficient key visual information for participants to recognise the gender (Brooks et al., 2008;
20 Alaerts et al., 2011), actions (Vanrie & Verfaillie, 2004) and even affective state and emotions
21 (Atkinson et al., 2004; Clarke et al., 2005; Heberlein et al., 2004) of the walker. Importantly,
22 unlike other types of pictorial stimuli such as emotional faces, PLW are stripped of their
23 ethnicity, as well as any other social or contextually meaningful information.
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45 PLW have also been used in clinical populations, particularly in those thought to have deficits
46 in social cognition and disordered social and/or emotion processing such as schizophrenia
47 (Okruszek & Pilecka, 2017), autism (Pavlova, 2012), as well as depression and anxiety. For
48 example, Loi and colleagues (2013) found that compared to healthy controls, participants with
49 unipolar depression struggled with recognizing happy emotions from PLW stimuli. PLW have
50 also been used to measure a type of interpretation bias called facing-the-viewer bias. In these
51 studies, PLW are ambiguous in terms of the direction they are moving in (either walking away
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3 or towards the viewer) and have been used to index participant's sensitivity to threat-relevant
4 information (Heenan et al., 2014). This bias has been investigated amongst anxious
5 participants, although the findings of these studies are mixed, with some reporting anxious
6 participants exhibiting a bias towards perceiving PLW as facing towards them (Yiltiz & Chen,
7 2018), and some reporting the opposite effect (Van de Cruys et al., 2013). Both types of effects
8 have been conceptually linked to the perception of threat, with a PLW walking away indicating
9 a "wishful thinking" bias (for avoidance of an interaction or a threat), and PLW walking toward
10 as a negative interpretation bias.
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24 Recently, PLW have been used to investigate threat perception. For example, Satchell et al.
25 (2021) presented participants with static and moving (PLW) images of 23 individuals who
26 previously self-reported high levels of aggressiveness. They found that PLWs (especially male
27 figures) were rated as more aggressive compared to static images, and participants were
28 generally accurate at recognising threat from PLW. To our knowledge, no other studies have
29 used PLW as a way of probing interpretation biases, including those in migrant groups.
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40 Building on previous research into the association between adverse life experiences, mental
41 health difficulties and threat biases in migrant populations, we sought to explore the
42 relationship between these factors in an undergraduate student migrant population. Although
43 interpretation biases have previously been explored in migrant populations (Yiend et al., 2019),
44 these did not include measures of mental health or other variables relevant to the migrant
45 experience. We selected several UK-based migrant groups in line with previous reports of
46 differences in the effects of ethnic discrimination on mental health that are dependent on
47 generational status. For example, second-generation migrants, defined as people who were
48 born and reside in a country that at least one of their parents previously entered as a migrant,
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3 appear to be impacted more by ethnic discrimination than first-generation migrants who were
4 born outside the country (Giuliani et al., 2018; Yazdiha, 2019). At the same time, much of this
5 research confounded ethnicity and migration (Lindert et al., 2008a). For example, White
6 migrants from Eastern Europe may also experience PMLD (Madden et al., 2017), and further,
7 may experience discrimination in the UK due to their foreign accents (Fernandez-Reino, 2020).
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11 Thus, in the current study we explored three participant groups: first- and second-generation
12 ethnic minority migrants and White first-generation migrants from non-English speaking
13 countries, allowing us to directly compare findings across these groups, while avoiding
14 confounding of ethnicity and migration status. In line with previous findings (Bustamante et
15 al., 2018; Fernandez-Reino, 2020; Giuliani et al., 2018; Steel et al., 1999), we hypothesized
16 that (H1) first- and second-generation ethnic minority migrant students and first-generation
17 White migrant students would differ in their experiences of PMLD, perceived ethnic
18 discrimination and mental health difficulties. Specifically, given inconsistencies in previous
19 findings, we tentatively predicted a gradient in mental health, PMLD and discrimination scores
20 running from high-to-low across first-generation ethnic minority, second-generation ethnic
21 minority, and first-generation White groups. With respect to interpretation biases, we predicted
22 that (H2) participants with poorer mental health, higher perceived ethnic discrimination and
23 higher PMLD scores would display interpretation biases for threat, rating all types of PLW
24 stimuli (positive, negative, neutral, and ambiguous) as lower on friendliness and higher on
25 aggressiveness scales.
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54 2 Method

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3 The study was approved by the ethics board of Queen Mary University of London
4 (QMERC2019/70) and participants gave written informed consent to take part. Participants
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6 were recruited through advertisement on campus and received a course credit or £7 for their
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8 participation. This study was not pre-registered.
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14 *2.1 Self-report measures*

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19 Participants provided basic demographic information including age and gender, in addition to
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21 information about existing mental health diagnoses, access to mental health treatment and
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23 length of stay in the UK. Participants were also asked about their subjective social status, which
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25 was measured by the MacArthur Scale of Subjective Social Status (Adler et al., 2000).
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27 Following this, participants completed the following three questionnaires in a randomised
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29 order.
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35 *2.1.1 Brief Symptom Inventory (BSI)*

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40 To measure mental health symptoms, the Brief Symptom Inventory (BSI) was used (Derogatis
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42 & Spencer, 1993). BSI is a 53-item measure with a five-point scale ranging from 0 (“not at
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44 all”) to 4 (“extremely”) that aims to assess how much a person has been affected by certain
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46 symptoms in the past seven days. It consists of nine subscales measuring primary symptom
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48 dimensions of somatization, obsession-compulsion, interpersonal sensitivity, depression,
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50 anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism. This scale has been
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52 widely used for both clinical and non-clinical populations. The BSI also includes three indices
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54 of global distress: Global Severity Index (GSI), Positive Symptom Distress Index, and Positive
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56 Symptom Total, which show good reliability and validity (Derogatis & Spencer, 1993). In this
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3 study, we report the GSI only, which is calculated as an average of scores on all 53 items. In
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5 the current study, Cronbach's alpha was 0.97 indicating high internal consistency.
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10 *2.1.2 Perceived Ethnic Discrimination Questionnaire (PEDQ)*

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14 We used the Perceived Ethnic Discrimination Questionnaire (PEDQ) to measure
15 discrimination (Contrada et al., 2001). This is a 22-item measure with a seven-point Likert
16 scale measuring the frequency of different discrimination events taking place in the past three
17 months, which ranged from 1 ("never") to 7 ("very often"). It consists of seven subscales:
18 verbal rejection, avoidance, exclusion, denial of equal treatment, devaluating action, threat of
19 violence, and aggression, although a total score was used for the purpose of this study. Scores
20 range from 22 to 154, with higher scores indicating more experiences of ethnic
21 discrimination/racism. This tool was selected due to its high validity and good reliability in
22 students and across different ethnic groups. Thus, many other tools have only been validated
23 in the US or are only appropriate for specific ethnicities (Atkins, 2014). The authors reported
24 good internal consistency (Cronbach's alpha = 0.81), and good construct validity using inverse
25 correlations with measures of mental health and prejudice (Contrada et al., 2001). In the current
26 study, Cronbach's alpha was 0.93 indicating high internal consistency.
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47 *2.1.3 Post-Migration Living Difficulties (PMLD) checklist*

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51 We used the Post-migration Living Difficulties (PMLD) checklist to measure the severity index
52 of issues students might have experienced as a result of being from a migrant group (Silove et
53 al., 1997). The checklist includes 22 items of the most common issues refugees and migrants
54 might experience in a host country, covering areas such as "meeting basic needs", "healthcare",
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3 “relationships”, “integration difficulties” and “housing problems”, although a total score was
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5 used for the purpose of this study. It is important to note that “discrimination” is also included
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7 in the checklist as one of the items. Participants rated items on a scale from 0 (“does not affect
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9 me”) to 5 (“very serious problem”) and had the option of adding up to four of their own items
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11 to the list and subsequently rating them as a standard part of the questionnaire. The scale is
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13 typically used to measure / count the number of severe and very severe issues migrants
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15 experience (Steel et al., 1999). However, the authors highlighted that this can be modified
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17 depending on the migrant group of interest. Since our group of interest was student migrants
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19 amongst whom we expected a less severe range of adverse experiences we calculated a total
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21 number of problems that were rated as “moderate” or above.
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28 *2.2 Point Light Walkers (PLW) Stimuli Selection*

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33 In order to identify PLW corresponding to four categories of action (positive, negative, neutral
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35 and ambiguous), 98 PLW animations were selected from a dataset of 500, obtained online or
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37 by contacting the authors (Alaerts et al., 2011; Heberlein et al., 2004; Lapenta et al., 2017;
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39 Manera et al., 2010; Shipley & Brumberg, 2005; Vanrie & Verfaillie, 2004). A subset of 35
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41 stimuli were used in the final study: five animations in each of the positive, negative, and
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43 neutral action categories, 15 animations in the ambiguous action category (see Supplementary
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45 Materials for choice selection). A further five scrambled animations comprised of randomly
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47 moving dots that are not representative of any human form or action and expected to be
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49 perceived as neither aggressive nor friendly were also included. Positive, negative, neutral, and
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51 ambiguous action stimuli were selected based on a pilot study undertaken by 33 undergraduate
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53 students (21 female, age range 19-32 [$M = 25.06$, $SD = 2.57$], see Supplementary Materials).
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3 Scrambled animations and the procedure for their generation can be found in Alaerts et al.
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5 (2011).
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10 *2.3 Testing protocol*

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14 Testing took part in two separate sessions. First, participants received an online link to a
15 consent form and questionnaires 24-hours prior to the lab-based component of the study and
16 were completed beforehand. Second, as part of a larger project, participants completed three
17 computerised tasks, including the interpretation bias task reported here. Testing was completed
18 in a dimly lit cubicle with the researcher present, who gave verbal instructions and ensured
19 participants' understanding of the task.
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30 The PLW stimuli were presented one at a time in randomised order via Qualtrics on a Dell PC
31 on a screen size of 44 x 25cm (1600 x 900 pixels). At the viewing distance of 57cm, one pixel
32 subtended 1.62 arcmin. The original PLW stimuli were of different sizes so were standardised
33 to the same height at presentation (6.66 degrees of visual angle) whilst maintaining their
34 original aspect ratios. The stimuli across all PLW types randomly varied in their duration of
35 action completion (between 1 and 12 seconds) and so were played on a continuous loop until
36 participants responded. Participants were asked to imagine having a social interaction with the
37 PLW and subsequently rate how: (i) friendly and (ii) aggressive the PLW were towards them
38 using a Likert scale from 0 ("not at all") to 3 ("very"). Participants were also asked an additional
39 question as to whether they would find this social interaction pleasant or whether they would
40 try to avoid it. However, due to an error in phrasing of the question (pleasantness and avoidance
41 were not rated separately), results of this question are not reported here.
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3 At the end of the study, participants were given a debrief sheet with information about the
4 study, aims and predictions for the experiments along with details of services available both
5 inside and outside the university for mental health support.
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10 11 12 **3 Results**

13 14 *3.1 Participants*

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19 An *a priori* power analysis was conducted using G*Power3 (Faul et al., 2007) to calculate the
20 minimum sample size for a two-tailed correlation between measures of interest and
21 interpretation biases, assuming a medium effect size ($r = 0.40$) at an alpha of .05 and power of
22 0.95. A medium effect size was selected based on previous studies on the relationship between
23 mental health and interpretation biases, which have reported medium-to-strong effect sizes.
24 Results indicated a minimum sample of 75 participants; however, as this experiment was part
25 of a larger study that focused on group differences on a *set* of three cognitive bias tasks, we
26 tripled this (minimum $n = 225$). A total of 230 participants (58 males; 25.22%) aged 18-33
27 years ($M = 21.26$, $SD = 3.32$) took part in the study. None of the participants were excluded
28 from data analysis.
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45 The participants were from three groups: first-generation ethnic minority migrants ($n = 94$),
46 second-generation ethnic minority migrants ($n = 68$), and first-generation White migrants ($n =$
47 68), all of whom were students. Nineteen participants (8%) reported a current mental health
48 diagnosis (primarily anxiety, depression, and eating disorders), seven of whom (3%) were
49 currently taking medication, and eleven (5%) were in therapy.
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There were group differences in the time spent in the UK (Table 1), with second-generation ethnic minorities having spent their whole life in the country. A Bonferroni corrected (corrected alpha = 0.02) independent t-test revealed no significant differences with respect to number of years in the UK between two first-generation migrant groups ($p = .032$). Regarding perceived social status, the only significant difference after Bonferroni correction was between White first-generation group who scored higher than second-generation ethnic minority groups, [$t(134) = 2.40, p = .018, d = 0.41$]. Across groups, students reported their social status on a ladder (ranging 1 to 10) just above the middle range ($M = 5.83$, Table 1).

Table 1*Participants' characteristics*

	1 st -generation migrants (White)	1 st -generation ethnic minority migrants	2 nd -generation ethnic minority migrants
<i>N</i>	68	94	68
Gender	21% male	36% male	15% male
Age, M (SD)	21.74 (3.53)	22.27 (3.74)	19.38 (1.32)
Ethnicity:			
<i>White – any other white background</i>	100%	0%	0%
<i>Black/Black British – African</i>	0%	7%	9%
<i>Black/Black British – any other Black background</i>	0%	1%	0%
<i>Mixed – White and Black Caribbean</i>	0%	1%	0%
<i>Mixed – White and Black African</i>	0%	0%	3%

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<i>Mixed – White and Asian</i>	0%	1%	0%
<i>Any other mixed background</i>	0%	3%	0%
<i>Asian/British Asian – Indian</i>	0%	27%	18%
<i>Asian/British Asian – Pakistani</i>	0%	16%	21%
<i>Asian/British Asian – Bangladeshi</i>	0%	6%	22%
<i>Asian/British Asian – any other</i>	0%	11%	9%
<i>Asian background</i>			
<i>Chinese</i>	0%	13%	1%
<i>Arab</i>	0%	6%	9%
<i>Any other background not stated</i>	0%	7%	9%
Time spent in the UK (years), <i>M (SD)</i>	3.54 (3.60)	5.41 (6.45)	19.02 (3.08)
Social status, <i>M (SD)</i>	6.06 (1.41)	5.95 (1.42)	5.47 (1.45)
In therapy / Medication	<i>N</i> = 4 / <i>N</i> = 4 (<i>N</i> = 2 PNS)	<i>N</i> = 4 (<i>N</i> = 2 PNS) / <i>N</i> = 1 (<i>N</i> = 3 PNS)	<i>N</i> = 3 (<i>N</i> = 1 PNS) / <i>N</i> = 2 (<i>N</i> = 2 PNS)
GSI, <i>M (SD)</i>	1.03 (0.68)	1.00 (0.76)	0.98 (0.72)
PEDQ, <i>M (SD)</i>	33.72 (13.06)	42.63 (20.08)	44.59 (20.18)
PMLD, <i>M (SD)</i>	3.94 (3.87)	7.26 (7.23)	3.44 (5.42)

Note. GSI = Global Severity Score (measure of mental health); PEDQ = Perceived Ethnic Discrimination; PMLD = Post-Migration Living Difficulties Checklist; PNS = Preferred not to say

3.2 Mental health, perceived ethnic discrimination and post-migration living difficulties

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3 To examine group differences between first- and second-generation ethnic minority and White
4 migrant participants in mental health (GSI), ethnic discrimination (PEDQ) and post-migration
5 living difficulties (PMLD checklist) we ran an ANOVA on GSI for which the assumption of
6 equal variances was met ($F(2, 227) = 0.78, p = .459$). Levene's test indicated unequal variances
7 for PEDQ ($F(2, 227) = 8.69, p < .001$) and PMLD checklist ($F(2, 227) = 22.34, p < .001$), thus
8 Kruskal-Wallis tests were used for these instead.
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19 The three groups did not differ significantly with respect to mental health ($p = .913$) (Table 1)
20 but did differ significantly on perceived ethnic discrimination ($\chi^2(2) = 13.11, p = .001$).
21 Consistent with H1, *Post-hoc* Bonferroni corrected Mann-Whitney tests revealed that White
22 participants' PEDQ scores were lower than those of first-generation ethnic minority migrants
23 ($U = 2422.50, p = .009$) and those of second-generation ethnic minority migrants ($U = 1477, p$
24 $< .001$). However, contrary to H1, first- and second-generation ethnic minority groups did not
25 differ in their perceived ethnic discrimination ($p = .427$).
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38 Finally, with respect to scores on the PMLD checklist a main effect of group was also found
39 ($\chi^2(2) = 13.14, p = .001$). *Post-hoc* Bonferroni corrected Mann-Whitney tests showed that first-
40 generation ethnic minority migrants experienced significantly more PMLD than second-
41 generation migrants ($U = 2247.50, p = .001$), but not more than White migrants ($p = .052$).
42 Second-generation and White migrants did not differ following a *post-hoc* Bonferroni
43 correction ($p = .018$), contrary to H1.
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54 3.3 Associations with interpretation biases

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3 Participant groups (first-generation ethnic minority, second-generation ethnic minority and
4 first-generation White) did not differ with respect to their mean ratings of friendliness or
5 aggressiveness for any of the five types of PLW (see Supplementary Materials). Consequently,
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10 we report analyses on data pooled across participant groups.
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14 To investigate the relationship between interpretation biases (as measured using friendliness
15 and aggressiveness ratings on the PLW) and our three measures of interest (GSI, PEDQ and
16 PMLD checklist) separate Spearman's bivariate correlations with bias-corrected and
17 accelerated (BCa) bootstrap interval procedure (1000 repeats) were run for each type of stimuli
18 (scrambled, positive, negative, neutral, and ambiguous). Bonferroni corrections were made for
19 ten multiple comparisons (corrected alpha = .005) reflecting two types of measures
20 (friendliness and aggressiveness) and five types of PLW stimuli analysed in relation to each
21 measure of interest (GSI, PEDQ and PMLD checklist).
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35 No significant correlations were found between our three measures of interest (GSI, PEDQ and
36 PMLD checklist) and friendliness ratings for scrambled, neutral, positive, negative, or
37 ambiguous PLW (Table 3.1). However, significant correlations were found between GSI and
38 aggressiveness ratings ($r = .24, p < .001$), as well as PMLD and aggressiveness ratings for
39 *scrambled* animations ($r = .23, p < .001$), and these survived correction for multiple
40 comparisons (corrected alpha=0.001). Thus, those who scored higher on measures of mental
41 health (GSI) and post-migration living difficulties (PMLD checklist) rated scrambled stimuli
42 as more aggressive. There were also curious associations between mental health and
43 aggressiveness rating for *ambiguous* stimuli ($r = .14, p = .029$), as well as between
44 discrimination and aggressiveness for *neutral* stimuli ($r = .13, p = .045$), although these did not
45 remain significant following Bonferroni correction (Table 3.1).
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Table 2

Correlations between stimuli ratings (friendliness/aggressiveness) and three measures of interest (GSI, PEDQ, PMLD checklist)

Stimulus type	Rating	GSI			PEDQ			PMLD		
		<i>r</i>	<i>p</i>	95% <i>CI</i>	<i>r</i>	<i>p</i>	95% <i>CI</i>	<i>r</i>	<i>p</i>	95% <i>CI</i>
Scrambled	Friendliness	-.06	.392	[-.19, .07]	-.07	.489	[-.17, .09]	-.05	.501	[-.18, .10]
	Aggressiveness	.24**	.001	[.11, .35]	.12	.070	[-.01, .25]	.23	.001**	[.10, .36]
Positive	Friendliness	.06	.338	[-.09, .20]	-.02	.744	[-.16, .13]	.08	.256	[-.06, .20]
	Aggressiveness	.08	.230	[-.04, .20]	.12	.074	[-.01, .24]	-.01	.965	[-.14, .14]
Neutral	Friendliness	.01	.847	[-.13, .15]	.06	.397	[-.09, .20]	.06	.361	[-.10, .22]
	Aggressiveness	.10	.143	[-.04, .22]	.13*	.045	[.01, .25]	.05	.436	[-.09, .18]
Negative	Friendliness	.10	.133	[-.04, .23]	-.03	.642	[-.16, .11]	.09	.164	[-.06, .23]
	Aggressiveness	.04	.537	[-.08, .17]	-.01	.987	[-.14, .13]	.05	.493	[-.09, .18]
Ambiguous	Friendliness	.11	.108	[-.03, .24]	-.01	.859	[-.14, .12]	.06	.403	[-.08, .19]
	Aggressiveness	.14*	.029	[.01, .28]	.09	.168	[-.05, .22]	.07	.288	[-.06, .20]

Note. GSI = Global Severity Index; PEDQ = Perceived Ethnic Discrimination Questionnaire; PMLD = Post-Migration Living Difficulties

* $p < .05$

** $p < .005$ (remaining significant following correction for ten comparisons)

4 Discussion

With respect to H1 (that there would be inter-group differences with respect to PMLD checklist, PEDQ and GSI scores with first-generation followed by second-generation ethnic and White EU migrants most severely affected), PMLD checklist scores were highest for first-generation ethnic minority migrants, and PEDQ scores were higher for both first- and second-generation ethnic migrants than first-generation White migrants. However, there were no differences in mental health scores between the three groups. Finally, with respect to H2, we found that none of the ratings (friendliness or aggressiveness) for the four PLW types that depicted human movement (positive, negative, neutral and ambiguous) correlated with measures of mental health, PMLD or ethnic discrimination. However, significant positive associations were found between aggressiveness ratings of scrambled PLW with mental health and PMLD checklist scores, although not PEDQ.

In our data, first-generation ethnic minority migrants experienced the highest number of PMLD relative to White migrants and to second-generation ethnic minority migrants, with no difference between the latter two groups. Previous studies exploring the differences between first- and second-generation migrants have tended to focus on PMLD in relation to mental health only (e.g. Usama et al., 2021) or else explored a wider range of migration difficulties in the two groups separately (Aragona et al., 2012; Gomula & Koziel, 2015). Further, these studies have traditionally excluded White migrants completely. Our finding that White migrant participants report similar numbers of PMLD to second-generation ethnic minority migrants warrants further exploration, particularly in light of the experiences and challenges faced by EU migrants in the UK following Brexit and the reported rise in racism and discrimination that this has brought (Virdee & McGeever, 2018).

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6 Our findings suggest that PMLD, although found to be less common in our student migrant
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8 samples than in other populations of immigrants (Aragona et al., 2012), still have a significant
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10 relationship with migrant students' mental health, although the cross-sectional design of the
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12 study precludes inferences about the underlying direction of causality. However, in our study
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14 there were no differences in reported mental health symptoms between the three groups
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16 included. This is at odds with previous literature that found that first-generation economic
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18 migrants were at a higher risk of depression, as a result of more post-migration and integration
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20 difficulties and discrimination, regardless of their ethnicity (Levecque & Van Rossem, 2014).
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22 One explanation for this discrepancy is that participants in this study were students, including
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24 international students, who might have a higher socioeconomic status (SES) and educational
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26 attainment than economic migrants investigated in earlier studies (Goodwin et al., 2018;
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28 Lindert et al., 2008b). In turn, higher SES has been linked to better mental health (Dohrenwend,
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30 1990), and greater likelihood of seeking mental health support (Steele, Dewa & Lee, 2007).
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32 Moreover, students have easier access to mental health services within the university, while
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34 (non-student) economic migrants receive support through national healthcare systems that can
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36 be slower and/or overburdened. Therefore, it is possible that the similarity in mental health
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38 scores reflects the biased nature of our sample, i.e. higher SES and educational attainment,
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40 which might offer greater protection against stressors.
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50 Lastly, we found no group differences in ethnic discrimination scores between first- and
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52 second-generation migrants, contrary to our predictions and several previous reports
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54 suggesting that second-generation migrants perceive more ethnic discrimination and are more
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56 psychologically impacted by it (Giuliani et al., 2018; Yazdiha, 2019). General scores obtained
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58 on the PEDQ were lower than other previously reported community samples, e.g. Brondolo et
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3 al. (2008), and although the measure included a wide variety of probable discrimination
4 settings, certain questions might have been less relevant for student populations, such as those
5 related to workplaces or owned property. Moreover, a lack of differences between first- and
6 second-generation ethnic migrants may also reflect the nature of the university where the study
7 was conducted. Queen Mary University of London is very ethnically diverse, and it is possible
8 that our students' experiences might be different from those of the general migrant population,
9 or perhaps even students studying in less diverse universities or cities in the UK. In support of
10 this, previous studies in the US have found that the effects of discrimination on ethnic minority
11 students' well-being could be especially pronounced for those attending predominantly White
12 universities (Neville et al., 2004).
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29 Finally, the main aim in this study was to explore associations between threat perception,
30 mental health, PMLD and perceived ethnic discrimination. We expected that the ratings for
31 positive, negative, neutral and ambiguous PLW would be associated with the aforementioned
32 measures, such that their friendliness and aggressiveness ratings would be negatively and
33 positively (respectively) correlated with mental health, PMLD and ethnic discrimination
34 scores. PLW have not previously been used in this context, but there is a large body of research
35 linking increased perception of threat in ambiguous stimuli to a variety of mental health
36 disorders (Beard & Amir, 2010; Bianchi et al., 2018; Elwood et al., 2007; Eysenck et al., 1991;
37 Yoon & Zinbarg, 2007). We found no support for hypothesis H3: neither aggressiveness nor
38 friendliness ratings for any of the PLW types depicting coherent human actions were associated
39 with our measures of interest. However, we did find evidence for increased threat perception
40 only (i.e. high aggressiveness but not friendliness ratings) with *scrambled* stimuli amongst
41 individuals scoring highly for mental health difficulties, PMLD and ethnic discrimination,
42 although the latter did not remain significant after correction for multiple comparisons.
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6 In terms of why the threat bias was only evident with scrambled stimuli, one possibility that is
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8 consistent with a Bayesian interpretation (Clark, 2015), is that the sought effect (i.e. bias
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10 towards threat perception) is relatively weak and hence only revealed under conditions of
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12 maximum uncertainty, i.e. conditions under which biases or prior expectations are most likely
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14 to be activated. Thus, scrambled stimuli contain *no* coherent actions. Nonetheless, it has been
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16 shown that healthy adults can identify emotions from *scrambled* PLW at an above-chance level
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18 based on local motion information alone (Spencer et al., 2016), and that ratings of animacy for
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20 scrambled PLW increased when the PLW animation was consistent with the direction of
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22 gravity (Thurman & Lu, 2013). The authors subsequently extended these findings to social
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24 interactions and found that participants identified social interactions in scrambled PLW at
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26 above-chance levels when stimulus motion energy was maintained (Thurman & Lu, 2014).
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28 Thus, despite their lack of *coherent action* and high uncertainty, such scrambled animations do
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30 contain information that participants interpret. In contrast, the other (coherent action) stimuli
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32 used in the study may have carried too much information (i.e. been of low uncertainty) to
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34 optimally reveal prior expectations. This is supported by the relatively modest ratings of
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36 ambiguity for these stimuli detailed in Supplementary Materials.
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45 With respect to its strengths, the current study is the first to directly investigate the relationship
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47 between mental health, PMLD and perceived ethnic discrimination, and to examine how these
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49 relate to positive and negative interpretation biases across three different migrant groups. By
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51 comparing first-generation ethnic, second-generation ethnic and first-generation White
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53 migrants we were able to explore how post-migration stressors link to mental health and
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55 cognition in these groups, whilst addressing existing limitations in the literature, including the
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57 fact that these groups have traditionally been studied separately (precluding direct
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3 comparisons) (Aragona et al., 2013; de Freitas et al., 2018; Ikram et al., 2015) and that EU and
4 international White migrants have traditionally been excluded (therefore confounding
5 migration and ethnicity) (Madden et al., 2017).
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12 This study contributes to a large body of research documenting the negative impacts of living
13 difficulties associated with the migrant experience (including discrimination) on mental health,
14 as well as the links between mental health and cognition. Future research should build on this
15 work, but also move towards an integration of the fields, exploring potential causal pathways
16 and mechanisms underlying such links. For example, previous research has suggested that
17 discrimination may impact adversely on cognition, particularly with respect to executive
18 functions such as inhibition, shifting and updating (see Ozier et al., 2019 for review), and that
19 such effects may amplify cognitive biases and heuristics that are associated with mental health
20 (Stanovich et al., 2016). Future research, building on our own findings using a perceptual
21 paradigm, might employ a longitudinal research design to explore whether the perceptual
22 biases we report play a mediating role in the association between well-established adverse
23 migrant experiences and the development of mental health difficulties.
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42 In addition to its strengths, there are some limitations to consider in this study. First, ambiguity
43 of coherent action stimuli was limited by the fact that our ambiguous PLW still performed a
44 clear action unlike other types of stimuli used in interpretation bias designs. It may be that
45 being able to identify an action, regardless of what it was, reduced the uncertainty required to
46 elicit a perception of threat. Second, it has been suggested by some that mental health disorders
47 such as anxiety are perpetuated by avoidance of threatening stimuli rather than an increased
48 perception of threat (Kashdan et al., 2013; Trew, 2011), although the two are obviously not
49 mutually exclusive. Therefore, in addition to measuring threat perception, it would be useful
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3 to measure avoidance of the stimuli. Finally, even though our stimuli fulfilled the selected
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5 categories of positive/negative/neutral social actions, it would be useful to control the perceived
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7 intensity and ambiguity of the action as is now possible from a new database of PLW (Okruszek
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9 & Chrustowicz, 2020).
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14 *Conclusion*

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19 The current study is the first to directly investigate the relationship between mental health,
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21 PMLD, ethnic discrimination and interpretation biases in first- and second-generation ethnic
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23 minority migrants and White first-generation migrants, facilitating direct comparison of
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25 parameters of interest without confounding ethnicity and migration status. We found that
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27 although the three groups did not differ on mental health measures, PMLD were higher in first-
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29 generation ethnic minority students and self-reported PEDQ scores were elevated in both ethnic
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31 minority participant groups. Further, we found that individuals scoring higher on one measure
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33 were more likely to score higher on the other two measures, suggesting that discrimination,
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35 mental health and PMLD likely co-occur, and potentially, share common etiological
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37 mechanisms. Finally, we found that PMLD and mental health difficulties were associated with
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39 increased perception of threat, although this was found for scrambled PLW stimuli only, i.e.
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41 under conditions of maximum uncertainty, that we would argue were most likely to elicit prior
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43 expectations / interpretation biases. These findings suggest that adverse life experiences
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45 associated with the student migrant experience may drive interpretation biases linked to poorer
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47 mental health; however, future studies are needed to elucidate the underlying mechanisms and
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49 directions of causality involved.
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Declarations

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Conflicts of interest: The authors have no relevant financial or non-financial interests to disclose.

Ethics approval: This study was performed in line with the principles of the Declaration of Helsinki. The study was approved by the ethics board of Queen Mary University of London (QMERC2019/70).

Consent to participate: Informed consent was obtained from all individual participants included in the study.

Consent for publication: The participant has been made aware that the data will be published in a journal and has provided their consent. There are no risks associated with participants being identifiable from the published data.

Availability of data and materials: The materials are available online or upon request from relevant authors (see Supplementary Materials for more details). The data is not available online but is available upon request from primary author (Anastasia Vikhanova, a.vikhanova@qmul.ac.uk).

Code availability: Not applicable.

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