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The "Wallpaper Effect" Revisited: Divergent Findings on the Effects of Intergroup Contact on Attitudes in Diverse Versus Nondiverse Contexts

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Abstract

This article reexamines the so-called "wallpaper effect" of intergroup contact, which contends that for minority group members living in areas more densely populated by majority group members, intergroup contact fails to reduce prejudice. We tested this claim in five studies, using data from five countries, two types of contexts, a range of measures, and involving different minority versus majority groups. Using multilevel cross-level interaction models, we considered whether effects of contact on outgroup attitudes were moderated by relative outgroup size. Results failed to replicate the previously reported findings, revealing, by and large, nonsignificant cross-level moderation effects; instead, we witnessed consistent positive contact effects on attitudes. Findings are discussed against the backdrop of recent research on the consequences of diversity, as well as context-based considerations regarding minority versus majority constellations. We also discuss some exceptions to our findings that emerged for some respondent groups and contexts across the five studies.

Keywords

intergroup contact, outgroup size, diversity, outgroup attitudes, wallpaper effect

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Having positive intergroup contact with people from different ethnic, racial, or other social backgrounds has long been found to yield positive effects on outgroup attitudes and is typically considered a key approach to reducing prejudice (Brown & Hewstone, 2005). However, there exists a potential caveat: Some studies suggest that contact might be more effective in reducing prejudice for members of majority or advantaged groups, compared with relatively disadvantaged minority group members (Tropp & Pettigrew, 2005).

A recent paper contends that one reason for the weaker contact effects among minorities is the composition of minority members' social environments (Barlow, Hornsey, Thai, Sengupta, & Sibley, 2013). Specifically, Barlow et al. suggest that contact only exerts the typically obtained positive effects for minority group members living in areas densely populated by fellow-ingroup members, but fails when minority members live in areas populated by relatively lower proportions of ingroup and relatively higher proportions of outgroup members (i.e., in contexts characterized by a larger outgroup size).

As intergroup contact is generally considered one of the most powerful strategies for reducing prejudice, supported by an impressive body of evidence (see Pettigrew & Tropp's, 2006, authoritative meta-analysis), we consider it crucial that any claims regarding the limitations thereof are subject to rigorous replication. As Barlow et al.'s (2013) paper is based on a single study involving data collected in a single context, we set out to replicate these findings. Our research is therefore consistent with recent calls for a greater emphasis on replication (alongside calls for other codes of research conduct and open scientific practice), especially in the psychological sciences, which highlight the need for researchers to

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be able to reproduce a given finding or set of results to ascertain the reliability thereof (e.g., Nosek et al., 2015). Indeed, a recent Open Science Collaboration (2015) has reported that a replication of 100 studies tended to produce weaker effects than the original studies, especially in the area of social psychology, offering a striking example of why continued replication studies are necessary (but see also a comment on this study by Gilbert, King, Pettigrew, & Wilson, 2016). Our attempt at replicating the "wallpaper effect" speaks directly to this call for replication.

Moreover, we also have substantive reason to believe that the wallpaper effect may not be universal, but may depend on the operationalization of key *measures* of intergroup contact and outgroup size, and possibly also on the specific sociopolitical *context* studied. The research presented here includes four cross-sectional studies and one longitudinal study, involves five different countries (England, Germany, the Netherlands, South Africa, and Sweden), tests effects in two different types of contexts (neighborhoods and schools), examines different minority versus majority constellations, and considers alternative models involving different measures of contact and ingroup–outgroup proportions.

Majority Versus Minority Group Effects of Intergroup Contact

Since its inception, hundreds of studies conducted in many different contexts have confirmed Allport's (1954) contact hypothesis, which stipulates that having contact with other groups, particularly if these encounters are positive and of high quality, has positive consequences for intergroup relations (Pettigrew & Tropp, 2006). Research documents the effectiveness of different types of contact, including direct quantity and quality of contact, cross-group friendship and extended contact (see, for example, Brown & Hewstone, 2005, for a review).

Notwithstanding this vast evidence base, some have suggested that intergroup contact may be more effective in reducing prejudice for majority than minority groups. Tropp and Pettigrew (2005) conducted a meta-analysis comparing overall effects of contact on prejudice between majority and minority groups, revealing a significantly lower, albeit still significant, effect size for minority ($r = -.18$) than for majority ($r = -.23$) groups. Several possible reasons for the typically observed lower magnitude of contact effects among minority group members have been suggested. For example, contact may be less effective for minority individuals as they tend to be aware of their group's devalued status in society and may thus expect to be a target of prejudice (Tropp & Pettigrew, 2005), a concern that does not always apply for majority groups. Also, Tropp (2007) found that intergroup contact is less effective among minority members who have experienced discrimination.

Barlow and colleagues (2013) provide another potential explanation. They argue that contact is less effective for minority group members living in contexts more densely populated by outgroup members; in other words, for minorities, contact should only work if they have relatively *fewer* opportunities for outgroup contact. Using a large general population sample derived from New Zealand that compared Māori minority group members and New Zealander European majority group members, Barlow and colleagues provided support for this assertion. While contact was positively associated with outgroup attitudes for the majority group, the contact effect was qualified by neighborhood composition for the Māori minority. Contact thus only positively predicted intergroup attitudes for minority members who lived in areas coinhabited by relatively more fellow-ingroup members (i.e., areas with a lower outgroup size); for Māori living in areas characterized by a larger outgroup size (i.e., areas with relatively lower proportions of fellow-ingroup members), the effects of intergroup contact were weaker.

The "Wallpaper Effect": On the Interplay Between Diversity and Intergroup Contact

In explaining their asymmetrical majority versus minority finding, Barlow et al. (2013) argue that the social environment for both majority and minority groups in most Western societies is typically one characterized predominately by majority individuals in most domains. Contact should therefore be more likely to bring about positive attitude change among majority than minority members, an effect they labeled a "wallpaper effect" of intergroup contact. As majority groups are used to their social environment (their "wallpaper") being one made up of fellow-ingroup members, coming into contact with minority members that effectively stand out from this background should thus be particularly transformative and thereby effect positive attitude change. Conversely, they argue, the reverse should be true for minority group members: Because minority individuals are typically exposed to contexts that are predominately characterized by majority outgroup faces in their everyday life, intergroup contact should be more commonplace and thus less likely to affect attitudes. The exception to this should be when minority members live in areas coinhabited primarily by fellow-ingroup members. It is thus here that contact with the majority should make a stronger impact for minorities, because, in these minority-dominated areas, contact with the majority is less commonplace.

Barlow et al. (2013) further draw on a body of research that has found that living in macro-level geographical regions (e.g., neighborhoods, cities or countries) made up of higher proportions of outgroup members has negative consequences for individual-level attitudes and prejudice (e.g., Quillian, 1996; Rae, Newheiser, & Olson, 2015). By and large, this research is rooted in the tradition of "Group Threat Theory" (or "conflict theory," for example, Blalock, 1967), a theory mainly based in the sociological and political science

literatures that seeks to explain how outgroup size at a macro level may negatively impact individual-level outcomes. Focusing primarily on explaining majority members' prejudice toward minority outgroups, this theory stipulates that contexts characterized by greater proportions of (minority) outgroup members inevitably invoke perceptions of competitive threat to the (majority) ingroup's position, which leads to intergroup tension.

However, there exists an important caveat to this argument. Although greater outgroup size at a context level might increase threat perceptions, contexts characterized by greater proportions of outgroup members also provide *opportunities for contact*, which are typically associated with actual contact (e.g., Wagner, Hewstone, & Machleit, 1989). Thus while most prior research in the group threat theory tradition has failed to actually measure contact on the individual level, there now exists a sizable body of research that provides converging evidence on the effects of context-level heterogeneity, intergroup contact, and outgroup attitudes.

Studies conducted, for example, in Germany (e.g., Pettigrew, Wagner, & Christ, 2010; Wagner, Christ, Pettigrew, Stellmacher, & Wolf, 2006), the Netherlands (e.g., Savelkoul, Gesthuizen, & Scheepers, 2011), the United Kingdom (e.g., Schmid, Al Ramiah, & Hewstone, 2014), and in Europe generally (Schlüter & Wagner, 2008) have all found that greater outgroup size or diversity at the context level is positively associated with positive intergroup contact (though there also exists research to suggest that exposure to diverse contexts or contexts including a larger outgroup size may simultaneously be associated with more negative forms of contact; for example, Schmid, Tausch, Hewstone, Hughes, & Cairns, 2008). Moreover, outgroup size at the context level has further been found to exert positive indirect effects on outgroup attitudes, via these positive effects of contact, both among majority (e.g., Pettigrew et al., 2010; Schmid et al., 2014; Wagner et al., 2006) and minority (e.g., Schmid et al., 2014) groups. In addition, recent work has uncovered a so-called "contextual effect" of intergroup contact. By comparing contact effects at the context level (e.g., a between-regions effect) with contact effects at the individual level (e.g., a within-regions effect), Christ et al. (2014) were able to demonstrate the effect of contact at the contextual level over and above respondents' individual level of contact.

The Present Research

In this article, we reexamine Barlow and colleagues's (2013) "wallpaper effect" of intergroup contact, by presenting replications in five separate studies, conducted in two different types of contexts, using different operationalizations of contact, and involving different majority versus minority groups. Yet beyond merely replicating in different countries this study that relied on a single dataset derived from New Zealand, our research was also driven by substantive and methodological considerations.

First and foremost, we emphasize the growing body of evidence showing the positive role that contact plays in affecting outgroup attitudes, especially in contexts characterized by higher proportions of outgroup members (e.g., Wagner et al., 2006), for both majority and minority groups (e.g., Schmid et al., 2014). Based on this research, and counter to the predictions of the "wallpaper effect," we consider it plausible that the effectiveness of contact may *not* be reduced in contexts characterized by relatively higher outgroup proportions. As having greater opportunities for contact (i.e., having more outgroup members around, or greater outgroup size in one's context) is typically associated with higher levels of intergroup contact, the effect of contact may not necessarily be dampened for individuals living in areas coinhabited by higher proportions of outgroup members.

In addition, we highlight some methodological considerations surrounding Barlow et al.'s (2013) study that may have influenced their findings. First, although their measure of intergroup contact assessed cross-group friendship, typically considered a highly effective form of contact (e.g., Davies, Tropp, Aron, Pettigrew, & Wright, 2011). Barlow et al. used a measure that assessed how many hours respondents spent with their outgroup friends in the last week. This is a somewhat problematic measure of cross-group friendship because being asked how much time you spend with your outgroup friends implies that you *have* outgroup friends to begin with; hence, this measure appears unable to address individuals who do not have outgroup friends, making it unclear how individuals without outgroup friends would have answered this question. Moreover, this measure does not capture specifically contact that occurs at the context level (i.e., the characteristics of the context that are thought to interact with individual-contact effects; in Barlow et al.'s case, the neighborhood). This points to one possible reason why Barlow and colleagues may have obtained their interaction effect, of contact only exerting positive effects for individuals who do not live in contexts coinhabited by outgroup members. Namely, that the possibility of having outgroup friends per se (i.e., friends who are perhaps unlikely to be located in the neighborhood, given the low outgroup proportions for these individuals) may make up for the lack of opportunities for contact in contexts dominated by fellow-ingroup members. Thus, it may not be the absence of opportunities for contact in one context (e.g., the neighborhood), but the presence of actual contact in other settings (i.e., general friendships, which are not necessarily bound to the neighborhood), coupled with the scarcity of contact in the neighborhood, that may be driving the effect. We thus argue that to draw conclusions on the interplay between contact and outgroup size, it matters which type of contact is being considered. In other words, it is important to consider specifically the contact that occurs at the context level (i.e., intergroup contact that happens in the specific context defining the macro-level unit at which outgroup proportions are measured). Notwithstanding this criticism, we understand

(not least from our own experience) that researchers are sometimes limited by the available items at their disposal, a common problem when working with secondary datasets, or when using data from general population samples where shorter and simpler measures need to be used to limit demands on respondents, time, and costs. It is thus particularly in such circumstances where replication becomes necessary, to ensure that any uncovered relationships do in fact reflect robust effects that also generalize to other operationalizations of key concepts.

Second, in operationalizing their context measure of group size, Barlow et al. (2013) rely on measures of ingroup size (i.e., the proportion of ingroup members present in respondents' neighborhood). One problem with this measure, however, is that it gives only a crude approximation of outgroup size, because ingroup size is not always perfectly negatively correlated with outgroup size and thus risks potentially misrepresenting the true configuration of outgroup members in the social context considered. This is especially the case where contexts are comprised of more than two groups. Thus, results showing significant interaction effects when using ingroup size as the moderator should be interpreted with caution. Such results may not necessarily mean that contact is less effective in promoting positive attitude change toward outgroup members if there are fewer outgroup members around, because one cannot be sure what the actual proportion of outgroup members is in a context (unless one also controls for the size of *other* minority groups in the context). For example, as Māori are not the only minority group in New Zealand (and indeed in most countries and contexts, there exist multiple minority groups), it is plausible that some respondents in their sample live in areas that they coinhabit not only with the respective majority outgroup but also with other minority outgroups. As a result of this diversity, lower ingroup size would not inversely translate into greater size of the outgroup under consideration. We therefore argue that focusing on ingroup size is not the best proxy for gauging relative outgroup proportions, in any context; instead, we deem it imperative to assess the size of the outgroup of interest by using the actual proportion of outgroup members in a context.

In this article, then, we follow Barlow and colleagues (2013) to examine the effects of intergroup contact and outgroup size on outgroup attitudes, as well as testing whether the effect of contact is moderated by outgroup size. We focus explicitly on intergroup contact that occurs within the specific context for which the data on outgroup proportions is relevant (i.e., the neighborhood in Studies 1 to 4, and the school context in Study 5), and use measures of outgroup size (as opposed to measures of ingroup size) as we consider these more appropriate operationalizations of the key concepts under study. However, to more rigorously replicate the study by Barlow and colleagues, we also report a set of alternative models, in which we consider (a) more general measures of cross-group friendship instead of contact that occurs specifically within the context and (b) ingroup size instead of outgroup size. We do so by testing these effects among majority and minority groups, in five different countries. Moreover, we not only examine these effects considering the neighborhood context but also seek to replicate effects in a different type of context, the school context involving adolescents attending schools characterized by varying ingroup versus outgroup proportions.

Based on the extensive body of prior research showing positive effects of contact on attitudes (e.g., Pettigrew & Tropp, 2006), we tested the following hypothesis:

> **Hypothesis 1 (H1):** Intergroup contact within the relevant context (i.e., neighborhood or school) will be positively related with outgroup attitudes, for both majority and minority groups.

We further considered two competing hypotheses, one based on the findings by Barlow and colleagues suggesting conditional effects of contact for minority groups (H2a), the other reflecting our aforementioned considerations that the effects of contact may not be moderated by outgroup size, based on prior research showing positive effects of contact in diverse contexts (H2b):

> **Hypothesis 2a (H2a):** The effects of intergroup contact will be negatively moderated by outgroup size for the minority group; for minority individuals, contact will only have positive effects on outgroup attitudes in contexts characterized by relatively fewer outgroup members. For majority members, there will be no negative moderation effect.
>
> **Hypothesis 2b (H2b):** The effects of intergroup contact will not be negatively moderated by outgroup size, for either the minority or the majority group; contact will have positive effects on outgroup attitudes regardless of the context.

Overview of Studies

We sought evidence for Barlow et al.'s (2013) "wallpaper effect" in four cross-sectional studies (Studies 1, 2, 3, and 5) and one longitudinal study (Study 4), involving data derived from the United Kingdom (Studies 1, 2, 4, and 5), South Africa (Study 3) as well as Germany, the Netherlands, and Sweden (Study 5). Each study was based on hierarchically ordered data, with adults nested in neighborhoods (i.e., small geographic areas defined by objective population data parameters; Studies 1-4) or students nested in school classes (Study 5), and each study included measures of intergroup contact within the given context (e.g., "How often, if at all, do you have positive interactions with [OUTGROUP] in this neighborhood?") assessed at the individual level (Level 1), outgroup size measured at the context (neighborhood or school) level based on objective population or class composition data

available at the contextual unit (Level 2), and outgroup attitudes measured at the individual level (Level 1; for example, a feeling thermometer measure asking respondents "How do you feel about [OUTGROUP]?"). In addition, we tested a series of alternative models, as we had measures of cross-group friendship available in all studies (e.g., "What proportion of your close friends are [OUTGROUP]?"), and were also able to estimate effects using measures of ingroup size in Studies 2 to 4 (in Studies 1 and 5, the measure of ingroup size was simply the inverse of outgroup size, so no alternative models are provided for these two studies). As our analytic strategy was similar for all studies, we first provide information on the methodology for each study consecutively before reporting the results in summary fashion. More detailed information on sampling, methodology, and measures for each study can be found in Appendix I in the Supplementary Online Materials (SOM).

Study 1

Respondents and measures. Study 1 focused on relations between White British majority members and ethnic minority members and involved data derived from a general population sample in England. The sample comprised 1,666 individuals (age range = 16-97 years), drawn from 224 neighborhoods, of which 868 were White British majority respondents (418 males, 450 females; M_{age} = 47.79 years) nested in 218 neighborhoods. Targeted oversampling yielded 798 ethnic minority respondents (431 males, 366 females, one unidentified; M_{age} = 37.73 years) nested in 196 neighborhoods.

Respondents completed measures of intergroup contact in the neighborhood (two items; White British: r = .49, p < .001; ethnic minority: r = .50, p < .001), cross-group friendship (two items; White British: r = .64, p < .001; ethnic minority: r = .57, p < .001), and outgroup attitudes (single item). Our measure of outgroup size was based on the relative proportion of outgroup members resident in the neighborhood. For White British majority members, this ranged from 1.05% to 84.38% (mean = 22.33%) ethnic minorities in the neighborhood; for the ethnic minority sample, this ranged from 9.88% to 97.42% (mean = 52.14%) White British in the neighborhood.

Study 2

Respondents and measures. This study focused on relations between White British majority members and Asian British minority members of predominately Pakistani, Bangladeshi, and Indian background, using a general population sample in the second largest city in the United Kingdom, Birmingham. The sample comprised 1,246 adults (age range = 18-91 years), drawn from 141 neighborhoods, of which 643 were White British majority respondents (312 males, 331 females; M_{age} = 49.60 years) nested in 121 neighborhoods. Targeted oversampling yielded 603 Asian minority respondents (297 males, 306 females, one unidentified; M_{age} = 37.86 years) nested in 123 neighborhoods.

Respondents completed measures of intergroup contact in the neighborhood (two items; White British: r = .82, p < .001; ethnic minority: r = .72, p < .001), cross-group friendship (single item), and outgroup attitudes (single item). The measure of outgroup size was based on the relative proportion of outgroup members present in the neighborhood. For White British majority members, outgroup size ranged from 1.08% to 78.18% (mean = 14.95%) Asians residents; for the Asian minority sample, it ranged from 2.25% to 90.78% (mean = 31.21%) White residents. Ingroup size was based on the relative proportion of ingroup members in the neighborhood. For Whites, ingroup size ranged from 6.38% to 92.44% (mean = 68.23%) White British; for Asians, it ranged from 1.49% to 86.76% (mean = 47.28%) Asians.

Study 3

Respondents and measures. Study 3 focused on relations between White South African historically advantaged (majority status) members and Black (African) and Colored (mixed-heritage) South African historically disadvantaged (minority status) members, using a random probability sample of South Africans living in Cape Town, South Africa.[1] The sample comprised 1,314 adults (age range = 18-65 years), of which 410 were White South African respondents (181 males, 229 females; M_{age} = 42.14 years) nested in 47 neighborhoods, 439 were Black South African respondents (186 males, 253 females; M_{age} = 34.32 years) nested in 57 neighborhoods, and 465 were Colored South African respondents (185 males, 280 females; M_{age} = 39.98 years) nested in 69 neighborhoods.

Respondents completed measures capturing intergroup contact in the neighborhood (single item), cross-group friendship (single item), and outgroup attitudes (single item). For all items, White respondents were asked about Black and Colored individuals, while Black and Colored respondents were asked about Whites. The measure of outgroup size was based on the relative proportion of outgroup members present in the neighborhood. For White respondents, outgroup size ranged from 0% to 34.58% (mean = 3.35%) Black residents, and from 0.61% to 67.86% (mean = 9.29%) Colored residents; for the Black sample, it ranged from 0% to 91.91% (mean = 8.07%) White residents; and for the Colored sample, it ranged from 0% to 91.91% (mean = 14.31%) White residents. Conversely, ingroup size was based on the relative proportion of ingroup members in the neighborhood (White respondents: 7.14%-94.98% White [mean = 80.01%]; Black respondents: 0%-100% Black [mean = 85.65%]; Colored respondents: 0%-100% Colored [mean = 76.53%]).

Study 4

Respondents and measures. Study 4 focused on relations between White British majority and Asian British minority members using a two-wave longitudinal dataset derived

from a general population sample in Oldham, a small town located in the North of England including substantial proportions of Asian British minority members of predominately Pakistani and Bangladeshi heritage. A total of 1,230 adults (age range = 16-90 years) took part in Wave 1 of the survey, while 683 of these respondents also took part in Wave 2 and constituted our final longitudinal sample, including 364 White British majority respondents (166 males, 198 females; M_{age} = 50.18 years) nested in 75 neighborhoods, and 319 Asian British minority respondents (144 males, 175 females; M_{age} = 34.07 years) nested in 35 neighborhoods.

Respondents completed measures of intergroup contact in the neighborhood (two items; White British: $r_{Time\ 1} = .63$, $p < .001$; $r_{Time\ 2} = .63$, $p < .001$; Asian British: $r_{Time\ 1} = .72$, $p < .001$; $r_{Time\ 2} = .61$, $p < .001$), cross-group friendship (single item), and outgroup attitudes (single item). For the White British majority, outgroup size ranged from 0% to 72.88% (mean = 4.08%) Asian British residents, while for the Asian British minority, outgroup size ranged from 8.70% to 98.60% (mean = 37.76%) White British residents. Ingroup size ranged from 20.79% to 99.37% (mean = 93.05%) White British for the White majority, and from 0.32% to 86.64% (mean = 55.14%) Asian British for the Asian minority.

Study 5

Respondents and measures. Study 5 focused on relations between majority students and immigrant minority students (i.e., students who were born, or had parents who were born, outside the survey country) in England, Germany, the Netherlands, and Sweden, and involved data based on the first wave of a student population sample (Kalter et al., 2014). The sample comprised 16,231 students (age range = 13-18 years) nested in 981 ethnically mixed school classes, including 9,571 majority students (4,751 males, 4,820 females; M_{age} = 14.95 years) and 6,660 immigrant minority students (3,262 males, 3,398 females; M_{age} = 15.09 years).

Students completed measures of intergroup contact in the school (single item), cross-group friendship (single item), and outgroup attitudes (single item). The measure of outgroup size was based on the relative proportion of outgroup students in the school class, as a percentage. For majority students, outgroup size ranged from 0% to 96.55% (mean = 26.42%). For immigrant minority students, outgroup size ranged from 0% to 96.67% (mean = 41.00%).

Results

To analyze our cross-sectional data from Studies 1 to 3 and Study 5, we estimated a series of multilevel random effects coefficient models to assess the effects of intergroup contact (Level 1) and outgroup size (Level 2), as well as the cross-level interactions between contact (Level 1) and outgroup size (Level 2) on outgroup attitudes (Level 1). For Study 4, we estimated a cross-lagged multilevel model, in which we modeled not only the forward paths (i.e., the effects of contact at Time 1, outgroup size at Time 1, and the cross-level interaction at Time 1 on outgroup attitudes at Time 2), but also the autoregressive effects of contact and attitudes at Time 1 on contact and attitudes at Time 2, respectively, as well as the effects of attitudes at Time 1 on contact at Time 2 (allowing us to assess the reverse paths between contact and attitudes).

For each study, these hypothesis tests are referred to as Model 1. In addition, we estimated a series of alternative models replicating analyses with measures of cross-group friendship instead of the context-specific contact measures, and with measures of ingroup size instead of outgroup size (Model 2). For Studies 1 and 5, the alternative model tests include only cross-group friendship. Correlations between variables are provided in Appendix II in SOM.

In each model test, we controlled for gender, age, and education (with the exception of Study 5, in which we only controlled for gender, because students were still in school and in age-homogeneous classes), all measured at Level 1, as these key demographic variables might influence outgroup attitudes. All variables were grand-mean centered. As our majority and minority samples were not always located in the same sampled contexts, we analyzed the data from each study separately for the majority and minority. The results for Model 1 (including neighborhood [Studies 1-4] or school [Study 5] contact and outgroup size) and Model 2 (including cross-group friendship and ingroup size) for Studies 1 to 5 are presented in Tables 1 to 7, respectively; for detailed description of the Model 2 results, see Appendix III in SOM.

Study 1

Results for Study 1 revealed support for H1 in Model 1: Intergroup contact was positively associated with outgroup attitudes for both the White British majority ($b = 0.36$, $SE = 0.08$, $p < .001$, 95% CI = [0.22, 0.52]) as well as the ethnic minority ($b = 0.41$, $SE = 0.09$, $p < .001$, 95% CI = [0.21, 0.60]) sample. Outgroup size was unrelated with outgroup attitudes for majority ($b = -0.45$, $SE = 0.42$, $p = .28$, 95% CI = [−1.29, 0.38]) and minority ($b < 0.01$, $SE < 0.01$, $p = .37$, 95% CI = [0, 0.01]) respondents. Finally, the interaction effect between intergroup contact and outgroup size failed to reach significance for either majority ($b = 0.47$, $SE = 0.36$, $p = .20$, 95% CI = [−0.25, 1.20]) or minority ($b < 0.01$, $SE < 0.01$, $p = .85$, 95% CI = [−0.01, 0.01]) respondents, thus supporting H2b (rather than H2a). An alternative model in which we considered cross-group friendship instead of neighborhood contact yielded similar effects (see Model 2, Table 1).

Study 2

Similar to Study 1, Study 2 revealed analogous effects for the White British majority group and the Asian British minority group. Intergroup contact was associated with more positive

Table 1. Cross-Level Interaction Models Predicting Outgroup Attitudes for White British Majority and Ethnic Minority Respondents (Study 1).

	Model 1		Model 2	
	Majority attitudes toward minority	Minority attitudes toward majority	Majority attitudes toward minority	Minority attitudes toward majority
	b (*SE*)	*b* (*SE*)	*b* (*SE*)	*b* (*SE*)
Level 1				
Neighborhood contact	0.36 (0.08)***	0.41 (0.09)***	—	—
Cross-group friendship	—	—	0.46 (0.10)***	0.24 (0.10)*
Gender	0.58 (0.15)***	0.18 (0.15)	0.60 (0.15)***	0.19 (0.15)
Age	<0.01 (<0.01)	0.01 (0.01)	0.01 (<0.01)	<0.01 (0.01)
Education	0.32 (0.05)***	0.09 (0.06)	0.30 (0.05)***	0.08 (0.06)
Level 2				
Outgroup size	−0.45 (0.42)	<0.01 (<0.01)	−0.25 (0.41)	<0.01 (<0.01)
Cross-level interaction term	0.47 (0.36)	<0.01 (<0.01)	0.17 (0.44)	<0.01 (<0.01)

Note. For model 1, the interaction term involved the product of neighborhood contact and outgroup size; for Model 2, the interaction term involved the product of cross-group friendship and outgroup size.
*$p < .05$. **$p < .01$. ***$p < .001$.

attitudes for the White British ($b = 0.46$, $SE = 0.08$, $p < .001$, 95% CI = [0.29, 0.62]) and the Asian British ($b = 0.40$, $SE = 0.08$, $p < .001$, 95% CI = [0.23, 0.57]) group, thus supporting H1. Outgroup size was unrelated with attitudes for the majority ($b = <-0.01$, $SE = 0.01$, $p = .50$, 95% CI = [−0.02, 0.01]) or the minority ($b < 0.01$, $SE < 0.01$, $p = .41$, 95% CI = [0, 0.01]). The interaction term between intergroup contact and outgroup size failed to reach statistical significance for White British ($b = <0.01$, $SE = 0.01$, $p = .37$, 95% CI = [−0.01, 0.01]) or Asian British minority ($b < 0.01$, $SE < 0.01$, $p = .31$, 95% CI = [<−0.01, 0.01]) respondents, therefore supporting H2b. The alternative model test (see Model 2, Table 2) revealed similar findings.

Study 3

In Study 3, we were unable to run Model 1 analyses for our Black subsample, due to a substantial amount of missing data on the neighborhood contact variable for this group only. For the White sample, we observed the predicted positive effects of intergroup contact, such that Whites who reported having more contact with Blacks ($b = 3.18$, $SE = 0.95$, $p < .001$, 95% CI = [1.31, 5.05]) and Coloreds ($b = 1.63$, $SE = 0.82$, $p < .05$, 95% CI = [0.01, 3.25]) also reported more positive attitudes toward these two groups, respectively. Coloreds ($b = 4.32$, $SE = 1.50$, $p < .01$, 95% CI = [1.35, 7.29]) also reported more positive attitudes toward Whites as a function of more positive contact with this group.

For Whites, outgroup size was unrelated with outgroup attitudes toward Blacks ($b = 0.04$, $SE = 0.38$, $p = .92$, 95% CI = [−0.71, 0.78]) or toward Coloreds ($b = 0.02$, $SE = 0.11$, $p = .88$, 95% CI = [−0.19, 0.23]), and outgroup size was also unrelated with attitudes toward Whites for Colored respondents ($b = -0.05$, $SE = 0.05$, $p = .32$, 95% CI = [−0.15, 0.05]).

The interaction effect of contact and outgroup size was nonsignificant for Whites' attitudes toward Coloreds ($b = -0.03$, $SE = 0.09$, $p = .78$, 95% CI = [−0.21, 0.16]), as well as for Coloreds' attitudes toward Whites ($b = -0.01$, $SE = 0.03$, $p = .89$, 95% CI = [−0.08, 0.07]). A significant interaction term did, however, emerge for Whites' attitudes toward the Black outgroup ($b = -0.77$, $SE = 0.31$, $p = .01$, 95% CI = [−1.39, −0.16]).

To elucidate the nature of this effect, we used multilevel simple slope analyses (Preacher, Curran, & Bauer, 2006) examining the effect of contact on attitudes for individuals residing in areas low in outgroup size ($M - 1SD$) with those residing in areas high in outgroup size ($M + 1SD$). This analysis revealed a significant positive effect of intergroup contact for White individuals living in areas where relatively fewer Black outgroup members lived ($b = 5.89$, $SE = 1.50$, $p < .001$), but no significant effect for Whites living in areas with relatively higher proportions of Black outgroup members ($b = 0.48$, $SE = 1.41$, $p = .73$). We next inspected the region of significance (RoS), which considers the specific values of outgroup size at which the relationship between contact and attitudes moves from significance to nonsignificance. Inspection of the RoS revealed that the relationship between contact and attitudes was only significant at values of outgroup size that fell below 1.48 and above 20.50 (centered values), respectively. Specifically, the relationship between contact and attitudes was positive and significant for White respondents living in areas where Black outgroup proportions were lower than 4.61%, negative for individuals living in areas where Black outgroup members made up more than 24.00% of the population, and nonsignificant for

Table 2. Cross-Level Interaction Models Predicting Outgroup Attitudes for White British and Asian British Respondents (Study 2).

	Model 1		Model 2	
	Whites' attitudes toward Asians	Asians' attitudes toward Whites	Whites' attitudes toward Asians	Asians' attitudes toward Whites
	b (*SE*)	*b* (*SE*)	*b* (*SE*)	*b* (*SE*)
Level 1				
Neighborhood contact	0.46 (0.08)***	0.40 (0.08)***	—	—
Cross-group friendship	—	—	0.86 (0.09)***	0.27 (0.09)**
Gender	0.21 (0.18)	0.18 (0.17)	0.21 (0.17)	−0.10 (0.17)
Age	<0.01 (<0.01)	<0.01 (0.01)	0.01 (<0.01)*	<0.01 (0.01)
Education	0.09 (0.06)	−0.03 (0.06)	0.06 (0.06)	−0.05 (0.06)
Level 2				
Outgroup size	<−0.01 (0.01)	<0.01 (<0.01)	—	—
Ingroup size	—	—	<0.01 (<0.01)	<0.01 (<0.01)
Cross-level interaction term	<0.01 (0.01)	<0.01 (<0.01)	<0.01 (0.01)	<0.01 (<0.01)

Note. For model 1, the interaction term involved the product of neighborhood contact and outgroup size; for Model 2, the interaction term involved the product of cross-group friendship and ingroup size.
*$p < .05$. **$p < .01$. ***$p < .001$.

Whites who lived in areas that fell between these lower and upper region boundaries. Important to note, however, is that only three respondents lived in areas where values of outgroup size exceeded the upper boundary of the region of significance involving more than 24.00% outgroup members; 80.70% of respondents lived in areas where values of outgroup size fell below the RoS boundary involving areas where Black outgroup proportions were lower than 4.61%. In other words, contact effects were positive and significant for the majority of White respondents in our sample.

The alternative model tests revealed similar findings for all groups, including the Black South African respondents (see Model 2, Tables 3 and 4), yet we did not witness any significant interaction effects between cross-group friendship and ingroup size.

Study 4

Results from Study 4 involved cross-lagged analyses, which revealed statistically significant autoregressive paths between attitudes at Time 1 and attitudes at Time 2 (White British majority: $b = 0.57$, $SE = 0.05$, $p < .001$, 95% CI = [0.46, 0.66]; Asian British minority: $b = 0.14$, $SE = 0.06$, $p < .05$, 95% CI = [0.02, 1.41]), as well as between contact at Time 1 and contact at Time 2 (White British majority: $b = 0.37$, $SE = 0.05$, $p < .001$, 95% CI = [0.27, 0.47]; Asian British minority: $b = 0.26$, $SE = 0.06$, $p < .001$, 95% CI = [0.14, 0.38]). Considering the forward paths, we only observed a significant contact effect at Time 1 on attitudes at Time 2 for the majority ($b = 2.05$, $SE = 0.74$, $p < .01$, 95% CI = [0.56, 3.45]); for the minority, there was no significant contact effect over time ($b = −1.08$, $SE = 1.12$, $p = .33$, 95% CI = [−3.12, 1.41]). Thus, we found only partial support for H1. Outgroup size was unrelated with outgroup attitudes for both the White majority ($b = 4.22$, $SE = 8.59$, $p = .62$, 95% CI = [−11.23, 22.60]), and the Asian minority ($b = 1.49$, $SE = 4.17$, $p < .46$, 95% CI = [−7.42, 9.14]). The interaction effect failed to reach statistical significance for either of the groups (White majority: $b = 5.12$, $SE = 7.62$, $p = .50$, 95% CI = [−15.48, 18.82]; Asian minority: $b = 1.23$, $SE = 3.89$, $p = .75$, 95% CI = [−5.46, 9.57]), providing support for H2b. Finally, considering the reverse path between attitudes and contact, we found no reverse effect for the majority ($b = 0.01$, $SE < 0.01$, $p = .16$, 95% CI = [0, 0.01]), or the minority ($b < 0.01$, $SE < 0.01$, $p = .61$, 95% CI = [−0.01, 0.01]). The alternative model tests revealed similar effects (see Model 2, Table 5).

Study 5

For Study 5, which involved the school context, we ran the analyses both for the full sample (i.e., including all countries in a single model estimation) as well as for each country separately. The findings for the full model consistently revealed significant positive effects of school contact for both the majority ($b = 0.32$, $SE = 0.02$, $p < .001$, 95% CI = [0.28, 0.36]) and the minority ($b = 0.44$, $SE = 0.03$, $p < .001$, 95% CI = [0.38, 0.50]). Findings for this overall model further revealed a negative effect of outgroup size in the classroom for the majority ($b = −0.07$, $SE = 0.02$, $p < .01$, 95% CI = [−0.11, 0.03]), but a positive effect for the minority ($b = 0.05$, $SE = 0.02$, $p < .01$, 95% CI = [0.01, 0.09]). The interaction between school contact and outgroup size was significant for both groups, yet effects were positive (i.e., counter to those obtained in Barlow and colleagues's paper; majority: $b = 0.06$, $SE = 0.02$, $p < .001$, 95% CI = [0.02, 0.10]; minority: $b = 0.12$, $SE = 0.02$, $p < .001$, 95% CI = [0.08, 0.16]).[2]

Table 3. Cross-Level Interaction Models Predicting Outgroup Attitudes Toward Blacks and Coloreds for White Majority Respondents (Study 3).

	Model 1		Model 2	
	Whites' attitudes toward Blacks	Whites' attitudes toward Coloreds	Whites' attitudes toward Blacks	Whites' attitudes toward Coloreds
	b (*SE*)	*b* (*SE*)	*b* (*SE*)	*b* (*SE*)
Level 1				
Neighborhood contact	3.18 (0.95)***	1.63 (0.82)*	—	—
Cross-group friendship	—	—	6.49 (1.35)***	2.47 (1.31)
Gender	3.94 (2.29)	3.62 (2.08)	3.55 (2.08)	3.06 (2.00)
Age	−0.05 (0.09)	<0.01 (0.08)	0.01 (0.08)	−0.01 (0.08)
Education	0.28 (0.53)	0.15 (0.49)	0.18 (0.49)	0.13 (0.47)
Level 2				
Outgroup size	0.04 (0.38)	0.02 (0.11)	—	—
Ingroup size	—	—	<0.01 (0.08)	0.03 (0.07)
Cross-level interaction term	−0.77 (0.31)*	−0.03 (0.09)	0.07 (0.09)	−0.08 (0.09)

Note. For model 1, the interaction term involved the product of neighborhood contact and outgroup size; for Model 2, the interaction term involved the product of cross-group friendship and ingroup size.
*$p < .05$. **$p < .01$. ***$p < .001$.

Table 4. Cross-Level Interaction Models Predicting Outgroup Attitudes Toward Whites for Black and Colored Minority Respondents (Study 3).

	Model 1		Model 2	
	Blacks' attitudes toward Whites	Coloreds' attitudes toward Whites	Blacks' attitudes toward Whites	Coloreds' attitudes toward Whites
	b (*SE*)	*b* (*SE*)	*b* (*SE*)	*b* (*SE*)
Level 1				
Neighborhood contact	—	4.32 (1.50)**	—	—
Cross-group friendship	—	—	5.81 (2.53)*	5.37 (1.58)**
Gender	—	2.44 (3.35)	−0.88 (2.29)	−0.04 (2.27)
Age	—	0.11 (0.13)	−0.15 (0.11)	0.11 (0.09)
Education	—	0.59 (0.56)	−0.82 (0.39)	<0.01 (0.40)
Level 2				
Outgroup size	—	−0.05 (0.05)	—	—
Ingroup size	—	—	0.03 (0.04)	0.01 (0.04)
Cross-level interaction term	—	−0.01 (0.03)	<−0.01 (0.05)	−0.03 (0.04)

Note. For model 1, the interaction term involved the product of neighborhood contact and outgroup size; for Model 2, the interaction term involved the product of cross-group friendship and ingroup size. No Model 1 test was run for Black South African sample due to substantial amounts of missing data on the neighborhood contact variable.
*$p < .05$. **$p < .01$. ***$p < .001$.

Considering each of the four countries separately revealed, by and large, comparable effects to the full sample analysis for both groups (see Model 1, Tables 6 and 7). Similarly, the alternative models were also generally in line with our Model 1 results (see Model 2, Tables 6 and 7), with the exception of a significant negative interaction effect that emerged for the Dutch majority students. Multilevel simple slope analyses unpacking this interaction showed that cross-group friendship of Dutch majority students was more strongly associated with outgroup attitudes in classes low in outgroup size ($M - 1SD$; $b = 0.28$, $SE = 0.03$, $p < .001$) compared with classes high in outgroup size ($M + 1SD$; $b = 0.18$, $SE = 0.03$, $p < .001$). Inspection of the RoS revealed that the effect of cross-group friendship on attitudes was only significant at values that fell below 2.44 and above 32.33 (centered values), respectively. Dutch majority students educated in classes in which less than 60% (i.e., lower boundary of RoS) of their classmates constituted outgroup members showed a positive relationship

Table 5. Cross-Lagged Cross-Level Interaction Models Predicting Outgroup Attitudes for White British and Asian British Respondents (Study 4).

	Model 1		Model 2	
	White British	Asian British	White British	Asian British
	b (*SE*)	*b* (*SE*)	*b* (*SE*)	*b* (*SE*)
Level 1				
$Attitudes_{T1}$ − $Attitudes_{T2}$	0.57 (0.05)***	0.14 (0.06)*	0.55 (0.05)***	0.13 (0.06)*
$Contact_{T1}$ − $Contact_{T2}$	0.37 (0.05)***	0.26 (0.06)***	0.37 (0.07)***	0.28 (0.07)***
$Contact_{T1}$ − $Attitudes_{T2}$	2.05 (0.74)**	−1.08 (1.12)	5.06 (1.81)**	2.52 (1.64)
$Attitudes_{T1}$ − $Contact_{T2}$	0.01 (<0.01)	<0.01 (<0.01)	<0.01 (<0.01)**	<−0.01 (<0.01)
$Gender_{T1}$ − $Attitudes_{T2}$	0.91 (1.84)	−7.74 (2.66)**	1.23 (1.70)	−6.79 (2.48)**
Age_{T1} − $Attitudes_{T2}$	0.02 (0.06)	−0.07 (0.11)	0.01 (0.06)	−0.02 (0.12)
$Education_{T1}$ − $Attitudes_{T2}$	0.89 (0.62)	1.82 (1.04)	0.99 (0.60)	1.97 (1.06)
$Gender_{T1}$ − $Contact_{T2}$	0.03 (0.12)	−0.16 (0.15)	0.01 (0.05)	−0.16 (0.10)
Age_{T1} − $Contact_{T2}$	−0.01 (0.02)*	−0.01 (0.01)*	<−0.01 (<0.01)	<−0.01 (0.01)
$Education_{T1}$ − $Contact_{T2}$	−0.01 (0.04)	0.11 (0.06)	−0.02 (0.02)	0.03 (0.04)
Level 2				
Group $size_{T1}$ − $Attitudes_{T2}$	4.22 (8.59)	1.49 (4.17)	−3.65 (6.84)	−0.89 (4.25)
Interaction $term_{T1}$ − $Attitudes_{T2}$	5.12 (7.62)	1.23 (3.89)	−13.97 (13.67)	−3.71 (6.10)

Note. In Model 1, "contact" refers to neighborhood contact, "Group size" refers to outgroup size and the interaction term refers to the product of neighborhood contact and outgroup size. In Model 2, "contact" refers to cross-group friendship, "Group size" refers to ingroup size, and the interaction term refers to the product of cross-group friendship and ingroup size.
*p < .05. **p < .01. ***p < .001.

between cross-group friendship and attitudes, while for students in classes where outgroup size exceeded 60%, no significant relationship between cross-group friendship and attitudes emerged. Important to note, however, is that in this sample, only 3% of students were in classrooms where outgroup proportions exceeded the lower RoS boundary; 97% of students were educated in classrooms in which outgroup size fell below 60%.[3]

Discussion

Our research constituted a systematic reexamination of the proposed "wallpaper effect," testing whether the impact of intergroup contact on outgroup attitudes is moderated by the proportion of outgroup members in one's immediate environment. We discuss our findings, first, by summarizing the contributions of this research to understanding the effects of contact on attitudes for both majority and minority members; second, by discussing potential reasons for the discrepancies between our work and research that previously obtained the "wallpaper effect" of contact; and, third, by addressing limitations and suggesting future research avenues.

Contributions of the Research

In five studies (four cross-sectional, one longitudinal) with data from Germany, the Netherlands, Sweden, South Africa, and the United Kingdom and involving different minority versus majority group constellations, in both neighborhoods and schools, we were unable to provide evidence for the "wallpaper effect" reported by Barlow et al. (2013). Out of the 39 model tests we conducted in total, 37 models failed to replicate the "wallpaper effect," which predicts that contact effects are weaker, or even nonexistent for individuals exposed to contexts of relatively larger outgroup size, either for the minority group or the majority group. In fact, in our school context in Study 5, we actually observed reverse effects to those observed in the original finding by Barlow and colleagues, such that positive interactions between contact and outgroup size emerged. Thus, both majority and minority members who had contact in classrooms characterized by relatively *higher* majority outgroup proportions held relatively *more* positive attitudes. We thus primarily witnessed the predicted effects of contact on attitudes, such that having more contact was generally associated with more positive outgroup attitudes for both minority and majority individuals. These findings support the vast body of research that shows positive effects of contact on outgroup attitudes (e.g., Pettigrew & Tropp, 2006), and, indeed, are also in line with findings by Barlow et al. (2013), who reported positive direct effects of contact on attitudes for both the European New Zealander majority and the Māori minority group.

Three specific findings merit further discussion: The positive interaction effects for both the majority and minority groups in Study 5 (which are opposite to the findings in the original paper); the significant negative interaction effects for the advantaged White South African respondents in Study 3 and for the Dutch majority group students in the Netherlands

Table 6. Cross-Level Interaction Models Predicting Outgroup Attitudes for Majority Pupils in Each Country (Study 5).

	Full sample		England		Germany		Netherlands		Sweden	
	b (*SE*)	95% CI	*b* (*SE*)	95% CI	*b* (*SE*)	95% CI	*b* (*SE*)	95% CI	*b* (*SE*)	95% CI
Model 1										
Level 1										
School contact	0.32 (0.02)***	[0.28, 0.36]	0.27 (0.03)***	[0.21, 0.33]	0.16 (0.03)***	[0.10, 0.22]	0.24 (0.02)***	[0.20, 0.28]	0.23 (0.04)***	[0.15, 0.31]
Gender	0.21 (0.02)***	[0.17, 0.25]	0.23 (0.04)***	[0.15, 0.31]	0.09 (0.05)	[−0.01, 0.19]	0.23 (0.04)***	[0.15, 0.31]	0.32 (0.05)***	[0.22, 0.42]
Level 2										
Outgroup size	−0.07 (0.02)**	[−0.11, −0.03]	−0.08 (0.03)*	[−0.14, −0.02]	−0.07 (0.03)*	[−0.13, −0.01]	0.05 (0.05)	[−0.05, 0.15]	0.07 (0.04)	[−0.01, 0.15]
Cross-level interaction term	0.06 (.02)***	[0.02, 0.10]	0.04 (0.03)	[−0.02, 0.10]	0.01 (0.03)	[−0.05, 0.07]	0.01 (0.03)	[−0.05, 0.07]	0.00 (0.05)	[−0.10, 0.10]
Model 2										
Level 1										
Cross-group friendship	0.20 (0.01)***	[0.18, 0.22]	0.15 (0.03)***	[0.09, 0.21]	0.08 (0.03)**	[0.02, 0.14]	0.23 (0.02)***	[0.19, 0.27]	0.13 (0.03)***	[0.07, 0.19]
Gender	0.20 (0.02)***	[0.16, 0.24]	0.20 (0.04)***	[0.12, 0.28]	0.08 (0.05)	[−0.02, 0.18]	0.21 (0.04)***	[0.13, 0.29]	0.33 (0.05)***	[0.23, 0.43]
Level 2										
Outgroup size	−0.02 (0.02)	[−0.06, 0.02]	−0.04 (0.03)	[−0.10, 0.02]	−0.04 (0.03)	[−0.10, 0.02]	0.09 (0.05)*	[−0.01, 0.19]	0.12 (0.04)**	[0.04, 0.20]
Cross-level interaction term	−0.02 (0.02)	[−0.06, 0.02]	−0.05 (0.03)	[−0.11, 0.01]	0.00 (0.03)	[−0.06, 0.06]	−0.05 (0.02)*	[−0.09, −0.01]	−0.05 (0.03)	[−0.11, 0.01]

Note. In Model 1, the interaction term refers to the product of school contact and outgroup size. In Model 2, the interaction term refers to the product of cross-group friendship and outgroup size.
CI = confidence interval.
*$p < .05$. **$p < .01$. ***$p < .001$.

Table 7. Cross-Level Interaction Models Predicting Outgroup Attitudes for Minority Pupils in Each Country (Study 5).

	Full sample		England		Germany		Netherlands		Sweden	
	b (*SE*)	95% CI	*b* (*SE*)	95% CI	*b* (*SE*)	95% CI	*b* (*SE*)	95% CI	*b* (*SE*)	95% CI
Model 1										
Level 1										
School contact	0.44 (0.03)***	[0.38, 0.50]	0.39 (0.06)***	[0.27, 0.51]	0.41 (0.03)***	[0.35, 0.47]	0.50 (0.06)***	[0.38, 0.62]	0.38 (0.07)***	[0.24, 0.52]
Gender	0.12 (0.03)***	[0.06, 0.18]	0.17 (0.05)***	[0.07, 0.27]	0.14 (0.05)**	[0.04, 0.24]	0.00 (0.05)	[−0.10, 0.10]	0.13 (0.05)*	[0.03, 0.23]
Level 2										
Outgroup size	0.05 (0.02)**	[0.01, 0.09]	0.10 (0.04)**	[0.02, 0.18]	0.06 (0.03)**	[0.00, 0.12]	0.06 (0.04)	[−0.02, 0.14]	0.03 (0.03)	[−0.03, 0.09]
Cross-level interaction term	0.12 (0.02)***	[0.08, 0.16]	0.09 (0.04)	[0.01, 0.17]	0.11 (0.03)***	[0.05, 0.17]	0.12 (0.04)**	[0.04, 0.20]	0.14 (0.05)**	[0.04, 0.24]
Model 2										
Level 1										
Cross-group friendship	0.35 (0.02)***	[0.31, 0.39]	0.37 (0.04)***	[0.29, 0.45]	0.36 (0.03)***	[0.30, 0.42]	0.40 (0.04)***	[0.32, 0.48]	0.26 (0.04)***	[0.18, 0.34]
Gender	0.10 (0.03)***	[0.04, 0.16]	0.10 (0.05)*	[0.00, 0.20]	0.14 (0.05)**	[0.04, 0.24]	−0.01 (0.05)	[−0.11, 0.09]	0.12 (0.05)*	[0.02, 0.22]
Level 2										
Outgroup size	0.05 (0.02)**	[0.01, 0.09]	0.04 (0.04)	[−0.04, 0.12]	0.09 (0.03)**	[0.03, 0.15]	0.09 (0.03)**	[0.03, 0.15]	0.03 (0.03)	[−0.03, 0.09]
Cross-level interaction term	0.04 (0.02)*	[0.00, 0.08]	0.06 (0.03)	[0.00, 0.12]	0.00 (0.02)	[−0.04, 0.04]	0.02 (0.03)	[−0.04, 0.08]	0.03 (0.03)	[−0.03, 0.09]

Note. In Model 1, the interaction term refers to the product of school contact and outgroup size. In Model 2, the interaction term refers to the product of cross-group friendship and outgroup size.
CI = confidence interval.
*$p < .05$. **$p < .01$. ***$p < .001$.

in Study 5 (which follow a similar pattern to those obtained in the original paper, albeit for the advantaged rather than the disadvantaged groups); and the lack of a significant longitudinal direct contact effect for the minority group in Study 4.

The significant positive interaction effects for both the majority and the minority groups in Study 5 are counter to the interaction effect reported by Barlow and colleagues. Contact with the majority group was thus particularly effective for students being educated in school contexts characterized by relatively *higher* outgroup proportions. The fact that we witnessed these positive interaction effects in Study 5 and not in the other four studies may be due to age-related and/or context-specific factors. It may thus be that younger adolescents are more likely to reap the benefits of contact, especially in settings in which they have high opportunities for contact. Indeed, recent research has shown that contact effects seem to be more effective at a younger age (Wölfer, Schmid, Hewstone, & van Zalk, 2016). Moreover, it may be that exposure to greater outgroup proportions in a school context (which perhaps has a normative climate in which social integration is promoted) has a more immediate and influential effect than exposure to relatively greater outgroup proportions in a neighborhood context. As students spend a considerable amount of their time in schools, school contexts may have a more lasting and significant effect on individuals than neighborhoods in which individuals may not necessarily spend a lot of their time (e.g., if they work or socialize in other areas). Moreover, effects obtained for students in school contexts are less likely to be due to potential selection effects than for neighborhoods. In other words, whereas more prejudiced adults may avoid living in neighborhoods with a higher outgroup size (and may thus miss out on contact opportunities), students have less choice over which schools, and within them which classes, they are assigned to. Consequently, students who initially hold negative views of outgroup members may be particularly likely to reap the benefits of mixing in diverse school classes (see Pettigrew & Tropp's, 2006, meta-analytic finding, that lack of choice is associated with greater effects of contact on prejudice). In addition, as school classes constitute much smaller contextual units than neighborhoods, students are more likely to actually engage in contact with outgroup members on a regular basis—something that may not occur, at least not at such a high level, in neighborhoods where individuals may not—either advertently or inadvertently—engage with outgroup members to the same extent.

However, we also observed two interaction effects similar to Barlow and colleagues. In Study 3, for the advantaged White South African respondents, we found a significant negative interaction between neighborhood contact and the size of the Black South African outgroup in the neighborhood. And in Study 5, the alternative model test yielded a significant negative interaction between cross-group friendship and outgroup size for Dutch majority students in the Netherlands. Similar to Barlow et al., effects of contact on attitudes were stronger for individuals living in areas less densely populated by outgroup members (Study 3) or for students in classrooms with lower outgroup proportions (Study 5). However, these findings do not replicate the original findings, because we observed this effect among the White advantaged (Study 3), and Dutch majority (Study 5) groups. These effects are thus different from the prior findings, in which the interaction occurred among the *minority/disadvantaged* group only. One could speculate of course that in the South African context, due to societal changes, Whites may perceive their traditional status as precarious and thus may perceive larger outgroup size at the neighborhood level as threatening. A similar argument cannot necessarily be made for the Dutch majority group in Study 5, however, for whom majority status should be less precarious (though there may nonetheless be a threat effect in operation for these students, which is something that future research may seek to examine). A further aspect to keep in mind is that for Study 3, we only obtained the interaction effect for our first model (which considered neighborhood contact and outgroup size). In the alternative model tests for this group, which involved relatively more similar measures to those by Barlow and colleagues (i.e., cross-group friendship and ingroup size), we failed to replicate the interaction effects. Moreover, in Study 5, we only witnessed the interaction effect for the Dutch students in the alternative model test, which considered cross-group friendship. This indicates that in our studies, the interaction effects that we did obtain do not represent robust effects; rather, our full range of results across all studies suggests the opposite: No reliable and robust conditional effect of contact on attitudes, moderated by outgroup size, exists.

Finally, we failed to observe a direct longitudinal effect of contact on attitudes toward White British people for the Asian minority respondents in Study 4. Although this finding runs counter to contact theory, it is not entirely surprising given that prior research has shown that contact effects tend to be of lower magnitude for minority than majority group members (Tropp & Pettigrew, 2005). Moreover, this finding may be due to potential analytical artifacts underlying the use of conservative cross-lagged analyses where high autoregressive stability between the same constructs measured at different time points can at times leave little variance to be explained.

Taken together however, our results suggest that the wallpaper effect should be considered provisional and possibly context specific. A single study drawn from a single country, opposed by five studies in five countries, provides a limited basis on which to conclude that intergroup contact is less effective among minority members who live in areas more densely populated by outgroup members. Moreover, in all our studies we had enough power to detect potential interaction effects in line with the proposed wallpaper effect, had they been there. The fact that we were unable to reliably replicate the original set of findings leads us to a different conclusion from that drawn by Barlow et al. (2013). In sum, we

find no evidence that within-context outgroup size dampens the positive effects of contact on attitudes.

Reasons for Discrepancies Between Prior and Current Research

We argue that the discrepancy between our findings and those previously reported by Barlow et al. (2013) may be due to two main factors: conceptual/methodological factors, and context-specific factors. Considering conceptual/methodological factors first, we believe that using outgroup as opposed to ingroup size is a more appropriate way to conceptualize and assess the proportion of outgroup members in the context, due to aforementioned reasons. Our research thus explicitly considered a measure of outgroup size to overcome this potential limitation. Nonetheless, we also replicated effects with measures of ingroup size, which did not change the pattern of effects much: Using either measure, our research failed to replicate the wallpaper effect.

Then we also argued that a general measure of outgroup friends may not be the most appropriate type of contact to consider when examining potential moderating effects of outgroup size. In our replication studies, we thus explicitly used contact measures at the context level (i.e., neighborhood or school) as well as measures tapping cross-group friendship. However, again, our general pattern of results did not differ much between the two types of contact, except in Study 5, where we uncovered a negative interaction effect similar to Barlow and colleagues, albeit for the Dutch majority only. Overall, this pattern of results suggests that the findings by Barlow et al. (2013) may not have arisen solely due to their measures; although their slightly suboptimal measure of cross-group friendship may still have accounted for some of the differences between their findings and ours, which used more standard measures of cross-group friendship.

A further reason for the discrepancy in findings may thus underlie unique peculiarities surrounding the previously studied intergroup context, New Zealand. In fact, Barlow et al. (2013) themselves suggest that New Zealand may differ from other countries in that the Māori minority is relatively integrated, with both English and Māori as official languages and with a clearly bicultural national identity promoted widely. The meaning of greater outgroup size could thus be different in this context, reflecting perhaps more positive norms about coexistence with outgroup members and/or a more inclusive superordinate identity, as opposed to threat effects that may be more prevalent in other sociopolitical contexts. Indeed, prior research on outgroup attitudes has found that positive effects of contact at a neighborhood level are mediated by positive social norms at the context level (Christ et al., 2014). In New Zealand, it may thus be that the conditional effects of contact observed for the minority sample are due to a lack of exposure to the more generally positive social norms in contexts characterized by higher outgroup size. Noteworthy, neither contact nor outgroup size correlated with threat perceptions in Barlow et al.'s (2013) New Zealand sample, making it unlikely that the effects uncovered in New Zealand are driven by increased threat in neighborhoods characterized by greater outgroup size. This again suggests that this sample may differ from the sociopolitical contexts we considered in our study. For example, prior research in two countries that we also considered in this study, Germany (e.g., Wagner et al., 2006) and the United Kingdom (e.g., Schmid et al., 2014), has found greater outgroup size/diversity to be associated with higher threat perceptions, while also exerting positive effects on contact which then accounted for positive indirect effects of outgroup size on outgroup attitudes, via reduced threat. Moreover, when considering both contact and threat pathways in tandem, this research obtained a nonsignificant net effect of diversity/outgroup size on attitudes. Future research should thus extend this work to consider the involvement of both social norms and perceived threat as potentially explanatory processes underlying the conditional effects of contact in diverse settings.

In addition, future research should examine some of the predictions of the ingroup projection model (see Wenzel, Waldzus, & Steffens, 2017), to test whether and when outgroup size may coincide with differing representations of the superordinate category as more or less complex. While a more complex superordinate category is one in which minority group attributes contribute to the prototypical and defining nature of the superordinate group, a less complex superordinate category tends to be more characteristic of the dominant majority prototype. For minorities, the former representation should reflect positive norms about inclusion and diversity, while the latter may constitute a threat to identity; for majorities, however, more complex representations may elevate threat if seen as undermining majority status and dominance. The meaning of superordinate identities may thus differ between the different countries considered, to the extent that minority members may be perceived, or perceive themselves, as more included in a shared national superordinate category in some countries than others, as a function of greater outgroup size.

Finally, future research may consider the link between outgroup size and group salience when considering conditional effects of contact on outgroup attitudes. For example, according to Mullen (1991), proportionate increases in outgroup size and decreases in ingroup size raise the salience of one's ingroup, which can lead to increased ingroup bias, particularly when the ingroup constitutes a minority in a context. Understanding the involvement of group salience in contexts characterized by differing majority versus minority proportions will further advance our understanding of potential boundary effects of contact.

Limitations and Future Research Directions

Notwithstanding the contributions of our research in providing an extensive replication of the previously obtained "wallpaper effect," we acknowledge some limitations. First, some

of our measures relied on single items; as noted earlier, this is sometimes the cost of working with large representative samples. Future research should thus replicate the effects using multi-item measures. Second, future research may consider not only contact effects in one context (i.e., neighborhood or school), but also consider multiple contexts in which contact occurs and explore the extent to which effects are moderated by outgroup size. An interesting avenue for future research would be to examine whether lack of contact in one context is compensated by presence of contact in another; for example, individuals may not have much neighborhood contact, but they may have contact with outgroup members in their workplace. Future research should consider this possibility by examining interactive effects of contact and outgroup size assessed in different contexts. Third, in Study 3, for the Black subsample, we also had substantial missingness on the neighborhood contact variable only; it thus remains for future research in this context to replicate results for this particular measure and group also. Finally, we focused narrowly on outgroup attitudes in examining conditional effects of contact for majority and minority groups. It would therefore be useful to also consider additional intergroup relations outcomes in future work. Moreover, it has been argued that contact, while promoting positive attitudes, may undermine collective action for minority or disadvantaged groups (e.g., Dixon, Durrheim, & Tredoux, 2007). Future research may thus consider the interplay between contact and outgroup size in affecting collective action, to examine whether exposure to contexts characterized by differing proportions of outgroup members yields diverging effects to those obtained here.

To conclude, our research constitutes an important reexamination of Barlow et al.'s "wallpaper effect," and their more general claim that intergroup contact "fails" to promote positive attitude change for minority groups living in more majority-dense contexts. We wish to stress that we do not challenge Barlow et al.'s findings per se; indeed, their findings offer important insights into the interplay between contact and ingroup size in New Zealand. However, we do question the generalizability of these findings across countries, and across different measures of key concepts. By having provided consistent counter-evidence—across five studies, in five different countries and two different contexts, and involving different majority and minority groups—our research calls for a more measured and revised conclusion concerning the effectiveness of contact in diverse settings. These findings are especially important in view of recent debates about (a) calls for replication (Open Science Collaboration, 2015) and (b) the potential negative impact of diversity on intergroup relations (e.g., Putnam, 2007). Our findings thus do not suggest that the effectiveness of contact is limited in diverse settings; rather, they strongly support the vast evidence base confirming the positive effects of contact for intergroup relations, not only among majority but also among minority members.

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Notes

1. The ethnic identifier "Colored" has long been used in South Africa to identify individuals of mixed-racial heritage, and to distinguish them from individuals of Caucasian, Indian, Asian, or African heritage. These ethnic labels remain in official use to track transformational targets at local, provincial, and national levels.
2. See Appendix IV for supplementary online material for detailed information on the interaction results for this study.
3. For all studies, we also considered another model including neighborhood/school contact, cross-group friendship and outgroup size, alongside all possible two-way interactions, and the three-way interaction. However, no significant negative two-way or three-way interactions emerged for any study.

Supplemental Material

Supplementary material is available online with this article.

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