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Do humans possess an autonomous system justification motivation? A Pupillometric test of the strong system justification thesis^{☆,☆☆}

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ABSTRACT

To investigate the existence of an autonomous system justification motive that guides human behavior, we tested the dissonance-inspired strong system-justification thesis: that the cognitive effort expended to justify societal systems on which people *depend*, is greater amongst the disadvantaged than amongst the advantaged when their group identities are weak in salience/strength. Using a novel pupil dilation paradigm to tap cognitive effort, we exposed an ethnic minority group ($N_{\text{total}} = 263$) to depictions of their ingroup as disadvantaged or advantaged after they had stated four things they liked about their ethnic group (strong group identity salience) or grandmother (weak group identity salience). We then measured fluctuations in their pupil diameter as they contemplated support for societal systems that were either relevant (high dependency) or irrelevant (low dependency) to their ethnic group. Results revealed that pupil sizes were larger in the group disadvantage condition than in the group advantage condition—indicating greater cognitive effort—but only when group identity was *salient* (Experiment 1) or when group identification was *strong* (Experiment 2). These effects occurred only for high dependency systems. Combined, this evidence contradicts the system-justification thesis, and questions the existence of an autonomous system justification motivation in humans.

The idea that human behavior arises from a motivation to satisfy psychological or material needs was sovereign within the social, political, economic and psychological sciences, until the advent of perspectives that de-emphasize self-interest, such as system justification theory (SJT; Jost & Banaji, 1994). Jost and Banaji (1994, p. 10) proposed a new kind of need that “does not [...] operate] in the service of protecting the interests of the self or the group” which they called the *system justification motive*. According to SJT, most humans possess a “tendency to defend, bolster and justify aspects of the societal status quo, often at a nonconscious level of awareness” (Jost, 2017a). Consequently, this tendency helps to ease uncertainties “on behalf of the system” (Jost, Pelham, Sheldon, & Ni Sullivan, 2003, p.18), even or indeed especially amongst those who are disadvantaged by such systems (Jost & Hunyady, 2005). Challenging the status quo can be risky and could potentially destabilize traditions to which people are

accustomed. Hence, the system motive operates to ensure system stability and, ironically, to help people to plan and control their lives.

Importantly, the strong system justification thesis assumes that the system motive operates mostly when the personal/group identities of the disadvantaged are relatively weak or nonsalient (Jost et al., 2003). Although we have disputed this claim on the grounds that it deviates from the original statements of Festinger (1962) (i.e., a dissonance-induced system justification should occur when group identities are relatively strong and important to the disadvantaged, see Owuamalam, Rubin, & Spears, 2016, 2018a, 2018b, 2019a, 2019b), there is as yet no *direct* empirical evidence to resolve this theoretical disagreement. Hence, we provide the first test of the dissonance-inspired and diagnostic version of the system justification thesis, using a novel pupil dilation paradigm that more directly taps dissonance effects (Hess & Polt, 1964). We undertook this test because the “strong system

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justification thesis” represents SJT’s most distinctive proposition that separates it from other mainstream theories. This thesis has generated enormous debate in the literature (e.g., Jost, Banaji, & Nosek, 2004; Reicher, 2004; Rubin & Hewstone, 2004; Spears, Jetten, & Doosje, 2001), and continues to do so (Brandt, 2013; Jost, 2017b; Owuamalam, Rubin, & Spears, 2016b), with a combined citation count exceeding 3000 (Google Scholar).

1. The debate

A central question in the debate between system justification researchers (Jost et al., 2004) and others (e.g., Owuamalam et al., 2019a, 2019b; Rubin & Hewstone, 2004; Spears et al., 2001) rests on how to *untangle* an autonomous system justification motivation from motives that are rooted in personal/collective interests. That is, assuming an autonomous system justification motivation exists, then there must be a way to demonstrate its existence unambiguously.

To this end, SJT researchers have proposed that an autonomous system justification motivation exists if people are supportive of societal systems that ultimately undercut their personal and collective interests (Jost & Hunyady, 2005, p. 261) and, all the more so, if they support such arrangements more strongly than those who benefit from them (Jost et al., 2003). This proposition is not without merit. The disadvantaged, amongst other instances, sometimes:

- show ambivalence towards their ingroup, and tend to favor higher-status outgroups over their own group in some cases, even at the *implicit/unconscious* level of awareness (Jost et al., 2004; Jost & Burgess, 2000);
- oppose policies aimed at resolving their material disadvantage (e.g., wealth redistribution) more so, or at least to the same degree as their advantaged counterparts (Henry & Saul, 2006; Jost et al., 2003; see Jost et al., 2004 for a review) and/or,
- are unwilling to engage in collective protest to address social inequity (Jost, Chaikalis-Petrakis, Abrams, Sidanius, & Van Der Toorn, 2012; Osborne & Sibley, 2013; cf. Osborne, Jost, Becker, Badaan, & Sibley, 2019).

However, a growing number of recent findings have cast doubt on the assumption of an autonomous system justification motive grounded in system-justifying attitudes amongst the disadvantaged. For example, evidence from controlled experiments (e.g., Trump & White, 2018), and large representative surveys (Brandt, 2013; Caricati, 2017; Kelemen, Szabó, Mészáros, László, & Forgas, 2014; Vargas-Salfate, Paez, Liu, Pratto, & Gil de Zúñiga, 2018), show either stronger system justification effects amongst the advantaged than the disadvantaged, or no difference at all. The existence of an autonomous system justification motivation is complicated further by Owuamalam, Rubin, Spears, and Weerabangsa (2017, Study 1). These authors showed that even in those instances where the disadvantaged support societal systems more strongly than the advantaged, that such behavior seems to be driven by collective interests (e.g., to manage the ingroup’s moral reputation, Hässler, Shnabel, Ullrich, Arditto-Vogel, & SimanTov-Nachlieli, 2018).

2. The critical but largely ignored issue

Previous studies on the topic have relied almost exclusively on self-reports that are often vulnerable to social desirability responding (e.g., Owuamalam, Rubin, & Issmer, 2016; Owuamalam, Paolini, & Rubin, 2017). None of the early studies in support of, or against SJT’s proposition have *directly* tested the *cognitive dissonance* basis for the system justification motivation using a method that is invulnerable to biases, especially under conditions in which group identities and interests are weak. This makes it profoundly difficult to conclusively accept or reject the existence of an autonomous system justification motivation that is predicated on there being supportive evidence for the strong system

justification thesis. As Jost et al. (2004) explained:

the strongest, most paradoxical form of the system justification hypothesis, which draws also on the logic of *cognitive dissonance* theory, is that members of disadvantaged groups would be even more likely than members of advantaged groups to support the status quo, *at least when personal and group interests are low in salience* (p. 909; emphasis added).

The logic behind this proposition is that supporting prevailing systems should not be difficult for those who benefit from them because such support works in favor of their self-interests. Hence, instances of system supporting attitudes amongst the *advantaged* are generally seen as being undiagnostic of an autonomous system justification motivation because it is difficult to believe that the advantaged are doing anything else than following their (self) interests.

In contrast, supporting unequal social arrangements is potentially at odds with the interests of groups that are disadvantaged by the relevant societal systems: significant cognitive effort is needed to make sense of, and live with such realities, given the ordinary tendency for people to act in their interests (Owuamalam, Paolini, & Rubin, 2017; see also Tajfel, Billig, Bundy, & Flament, 1971). As Jost et al. (2003, p.16, *our emphasis*) explained, “a hybrid of dissonance theory and system justification theory would predict that *those who suffer the most also have the most to explain, justify, and rationalize*” (but see the section on cognitive dissonance theory below). It is often difficult to change societal traditions, especially when they are legitimate and stable (Jost et al., 2004, 2012) and so SJT assumes that the disadvantaged are drawn towards aligning their attitudes with the status-quo because this is easier to do. In short, the cognitive effort expended in justifying disadvantageous societal systems, is regarded as being diagnostic of the existence of an autonomous system justification motivation. Importantly, SJT proposes that they do this only or especially *when group interests and/or identities are subjectively weak* (Jost et al., 2004), because then personal and/or group motives cannot interfere with system justifying attitudes/behaviors (see also Brandt, 2013).

2.1. The system dependency caveat

Consistent with the dissonance perspective (Festinger, 1962) recent reformulations of the system justification thesis (e.g., the system dependency caveat, Kay et al., 2009; see also Jost, 2019) propose that the system justification motivation should be most visible when people are dependent on their social systems for some benefit (see also van der Toorn et al., 2015). This system dependency caveat assumes that the disadvantaged should care enough for the relevant system to expend cognitive resources/effort justifying its maintenance at the expense of advancing their own personal/group interests. Hence, a true test of the dissonance-inspired strong system justification thesis should demonstrate that greater cognitive effort is expended in justifying systems on which peoples’ “livelihoods depend” (Jost, 2017a, 2017b p.73). In short, to establish that an autonomous system justification motive exists, one should show that the disadvantaged expend greater cognitive effort in justifying societal systems—*especially those systems that they depend on*—when their group identities are relatively weak in salience or when their group identification is weak.

3. An alternative view based on cognitive dissonance theory

An alternative proposition, based on the original statements of the cognitive dissonance theory, is that dissonance effects should manifest most strongly amongst the disadvantaged when the competing realities are self-relevant and important (Owuamalam et al., 2016; Owuamalam et al., 2018a, 2018b; Owuamalam et al., 2019a, 2019b). As Festinger (1962, pp. 179–180) explained:

The magnitude of the dissonance, of course, will also be affected by

those variables that affect the importance of the cognitive elements involved in the dissonance. The more important the elements, the greater will be the magnitude of the dissonance.

Hence, from a cognitive dissonance standpoint, the disadvantaged should expend greater cognitive effort in rationalizing systems that are important to them when their group identification is strong and important to them; or when their group identities are salient and therefore relevant to them (Owuamalam et al., 2016; Owuamalam et al., 2018a, 2018b; Owuamalam et al., 2019a, 2019b). Jost (2019) has objected to the supportive *indirect* evidence for this alternative view (e.g., Owuamalam et al., 2016) on the grounds that the conceptualization of systems, and the design of the experiment itself leaves much to be desired (see also Jost, Badaán, Goudarzi, Hoffarth, & Mogami, 2019). Here we used clear-cut examples of conventional societal systems and an established but nonetheless novel pupillometric technique that directly taps cognitive effort (see Hess & Polt, 1964).

4. Pupillometric measurements of cognitive effort

One of the key functions of the pupil is to enable vision by regulating the amount of light that enters the eye via the actions of the constrictor and dilator muscles in the iris, which are respectively controlled by the parasympathetic and sympathetic nervous systems. While the dilator muscles function to increase pupil sizes in dark conditions, the constrictor muscles shrink pupil sizes in well-lit conditions (Sirois & Brisson, 2014). Importantly, pupil size fluctuations are also sensitive to information processing, so that the greater the cognitive demands, the wider the pupil diameter becomes (Sirois & Brisson, 2014). Given this function, researchers have used dilations in the pupil diameter to measure cognitive effort (Sirois & Brisson, 2014). This makes pupillometric reflexes a particularly useful approach to measuring dissonance-based justification processes, because they are automatic and consequently less vulnerable to deliberate distortion, compared to self-report measurements of system justification that can be influenced by image management bias (e.g., Owuamalam et al., 2016, Study 1).

Indeed, there is ample evidence that increases in pupil diameter taps cognitive effort with precision (e.g. Kahneman & Beatty, 1966; Querino et al., 2015). For example, classic studies adopting a mental stress paradigm in which participants are given difficult versus easy tasks generally show that the pupil dilates when the task is difficult rather than easy (e.g. Hess & Polt, 1964; Kahneman & Beatty, 1966; Metalis, Rhoades, Hess, & Petrovich, 1980; see also Sirois & Brisson, 2014 for a review). We focused on pupil dilations as an index of the cognitive effort implied by a dissonance-induced system justification: a) because dissonance assumes that competing choices are operational and should demand greater effort to process than non-conflicting ones; and b) because “pupil dilation appears to index the processes involved in decision making” (Sirois & Brisson, 2014, p. 682). In short, the aim was to determine whether pupil dilations—that indicate cognitive effort—are larger amongst the disadvantaged (than the advantaged) when system justifying decisions are contemplated in situations where the salience/strength of their group identity is weakened (as per the strong system justification thesis) or strengthened (as per the alternative view based on cognitive dissonance theory).

5. Experiment 1

5.1. Method

5.1.1. Sample size estimation

Assuming a moderate effect size ($f = 0.25$), with alpha and power set at respectively 0.05 and 0.80 (Cohen, 1988), we estimated using G*Power (Faul, Erdfelder, Lang, & Buchner, 2007), that a 2×2 design with a moderating covariate will require 128 cases to achieve a significant critical F -value of 3.92, assuming a single datapoint per

participant. This estimate guided data collection effort in this experiment, and the subsequent replication.

5.1.2. Participants and design

One-hundred and-thirty-two ethnic Chinese Malaysian students were randomly recruited at a university campus by a Chinese research assistant to participate in this study (84 were women, $M_{age} = 21.33$, $SD_{age} = 2.53$). Participants were randomly assigned into one of 4 cells of a 2 (group status: disadvantaged, $n = 66$ vs. advantaged, $n = 66$) $\times$ 2 (identity salience: salient, $n = 66$ vs. nonsalient, $n = 66$) design, while group identification was measured. These three factors were the focal independent variables. Participants' pupil sizes as they contemplated (and indicated) their support for various societal systems were measured, and both of these measures represented the key dependent variables.

5.1.3. Apparatus

The materials and stimuli for this study were presented on a 17-inch monitor that was equipped with Tobii T120 eye-tracking capability. This device records pupil dilation at a constant data rate of ~ 60 Hz with a sampling rate standard deviation of 0.003 Hz (Tobii Technology, 2010). A Dell laptop running the Tobii Studio software (version 3.3.1) was used to program the experiment, and the questionnaires that were constructed in Qualtrics survey suit were linked to the Tobii eye-tracker via this software. A chin rest was provided to participants to ensure accurate pupillometric measurements. This chin rest was placed approximately 65 cm to the Tobii monitor and helped to ensure minimal head movements. Because luminance can affect the precision of pupillometric measurements (Hammond & Mouat, 1985) we blinded the windows adjacent to the Tobii monitor with black plastic bags to maintain a constant lighting across participants with daylight fluorescent tubes that were suspended on the ceiling.

5.1.4. Materials and procedure

Participants were told that the study was about social attitudes and perceptions and that they will be required to respond to questions about a series of systems and institutions in Malaysian society. Participants then underwent a gaze calibration protocol and were told this was necessary in order to ensure that they paid attention to the tasks. In reality the gaze calibration was designed to ensure that a) the Tobii eye-tracker was capturing their gaze, and b) their gaze could reach the different angles on the screen.

5.1.5. Identity salience and strength

The *salience* of participants' ethnic identity was manipulated by focusing participants' attention to the ingroup as a whole. For the second group, participants were encouraged to focus on their grandmother, and this was meant to invoke a more interpersonal context in which individual identity is likely to be more salient than the group identity. This approach is underpinned by self-categorisation theory (Turner, 1999) to the extent that a) people categorise themselves at different levels of abstraction and, b) the salient self in a situation is the primary driver of social behavior. Specifically, in the strong group identity salience condition, participants were asked to write down four things they liked about their ethnic Chinese Malaysian identity, while in the weak group identity salience condition participants wrote four things they liked about their grandmother (see Panel A, Table 1).

5.1.6. Group status manipulation

Next, we capitalized on the relatively unique feature of Malaysian society, in which ethnic Chinese are a minority group that suffer political disadvantage but, at the same time, are more economically successful than other ethnic groups. This context makes it possible to meaningfully manipulate group disadvantage vs. advantage amongst ethnic Chinese Malaysians while retaining the real-world relevance that an actual (rather than fictitious) group presents (see Owuamalam,

Table 1
The group identity salience x group disadvantage treatments across experiments 1 and 2.

Experimental conditions	
Treatment variable: group identity salience	
Strong	Weak
1. What does your Chinese identity mean to you? 2. How do you feel about being a Chinese? 3. What is the most important thing you would share with the world about your Chinese identity? 4. What do you like so much about your Chinese identity?	1. What does your grandmother mean to you? 2. How do you feel about your grandmother? 3. What is the most important thing you would share with the world about your grandmother? 4. What do you like so much about your grandmother?
Experimental conditions	
Treatment variable: group status	
Disadvantaged	Advantaged
The system of providing educational subsidies in Malaysia has been based on the spirit of the National Education Policy (1961) and the New Economic Policy (1971) that Malaysia adopted following independence. These policies are aimed to significantly raise the attainment of Malays, often at the expense of other groups in Malaysia such as the Chinese. In particular, these policies provide quotas for Malay students in higher education to receive MARA government scholarships even when higher achieving Chinese students do not receive similar support. Moreover, under these policies some government positions are reserved for Malays, while private businesses owned by the Chinese are required to hire Malays and are often denied access to UMNO-led government loans when Chinese-owned companies fail to meet this requirement.	The Chinese are considered one of the wealthiest ethnic groups in Malaysia and have been more prosperous than other ethnic communities. In 2001, Malaysian Business released its list of 20 richest Malaysians – 16 of the 20 and 9 of the top 10 were ethnic Chinese. The Chinese have the lowest poverty rates amongst major ethnic groups in Malaysia. For example, average income rose from RM 394 in 1970 to RM 4279 in 2002 amongst Chinese Malaysians - 80.0% above the average Malay income, and 40.5% above the average income amongst Indians. Moreover, the Chinese have the highest household income amongst the three major ethnic groups in Malaysia. The monthly average household income was RM 4437 in 2007. These statistics reflect the historical dominance of the Chinese in finance, commerce and economic sectors.

Paolini, & Rubin, 2017). Research has shown that activating a mindset of group disadvantage depends on who people compare themselves to, or the specific status-relevant dimension on which such comparisons are based (Caricati, 2017; Caricati & Sollami, 2017; Owuamalam, Rubin, & Issmer, 2016; Tajfel & Turner, 1979). Hence, in the group disadvantage condition, we reminded participants about their political disadvantage in Malaysian society relative to the Malay majority outgroup in various ways. For example, through the MARA scholarship policy – an initiative that helps the majority ethnic group (Malays) at the expense of minority groups (including ethnic Chinese). In the group advantage condition, participants' focus was directed to their ethnic group's economic success relative to other ethnic groups in Malaysia (see Table 1, Panel B).

5.1.7. *Dependent measures*

The system is interpreted in SJT framework as including sub-components of an overarching system/order in which people are advantaged or disadvantaged (Jost et al., 2004; Kay & Zanna, 2009; cf. Owuamalam et al., 2018a, 2019a, 2019b). If system justification amongst the disadvantaged is induced by dissonance in the SJT sense, then according to SJT, the cognitive effort expended to *justify* sub-components of an overarching order that is disadvantageous to one's social identity should be greater when a) people are strongly rather than weakly dependent on such systems; b) group identity is rendered *nonsalient or weak* (versus salient/strong, Jost et al., 2004); and/or c) group identification is weak (rather than strong). Such an effect should manifest itself in the form of increased pupil sizes as the disadvantaged contemplate support for relevant societal systems.

To operationalize *system dependency*, participants were asked to indicate their support for four Malaysian (sub-) systems that we chose on the basis of the extent to which the livelihoods of ethnic Chinese Malaysians might depend on them (Owuamalam et al., 2017). These included 2 sub-systems that are unambiguously relevant to ethnic Chinese peoples' survival (transportation and healthcare systems) and 2 sub-systems that they are ostensibly less dependent on (MARA scholarships, UMNO political party). The MARA scholarship scheme was introduced by the Malay-led ruling party in Malaysia to help close the

higher education gap between the Malays and the economically more successful Chinese minority. Given that our Chinese participants were already in higher education, and the fact that none of them were in receipt of the MARA scholarship, we reasoned that participants will be less dependent on this sub-system. Similarly, UMNO (United Malays National Organization) is a political party that is generally seen as the party of the majority Malay outgroup, created to advance the political/economic interests of the Malays rather than the ethnic Chinese minority. That is, ethnic Chinese Malaysians are unlikely to be highly dependent on MARA scholarship and UMNO political sub-systems, at least relative to transportation and healthcare sub-systems that are more closely linked to survival, following Kay et al.'s (2009, p.425) examples of high dependency systems. In short, these micro-systems are subsumed within the overarching 'Malaysian system' in which Chinese Malaysians are disadvantaged—at least politically—relative to the majority Malay outgroup (see Owuamalam et al., 2018b for a typology of societal systems).

Unbeknownst to participants, their pupil sizes were recorded as they contemplated support for the sub-systems we exposed them to. It was important too that the experience of dissonance preceded self-reported system justification and this consideration informed the capture of pupil measurements prior to the rating scales: when participants are making their support decisions. This was done to rule out the alternative possibility that self-reported system justification actually reduces dissonance if pupil measurements were captured at the point where participants were merely reporting a decision that has already been made.

Participants saw an instruction slide that reminded them to rate the fairness, perceived confidence and functionality concerning each sub-system following previous studies that have used either of these three indices to operationalize system justification (e.g. Brandt, 2013; Caricati, 2017; Jost et al., 2003; Kay et al., 2009). Participants could exit the instruction slide (with timing set at infinity) by pressing any key on the keyboard, which was then followed by a screen containing one of the sub-systems they were to give their opinions on. That is, there was one word describing a sub-system on each slide and our interest was on the pupil size fluctuation(s) for this slide alone. The word

denoting the relevant sub-system was written in 50-point Calibri font on a dark grey slide with white ink¹ and this was presented in the center of the screen for 5000 milliseconds (ms, see flow diagram in Fig. 1). To maintain roughly equivalent levels of luminance across each system stimulus—given the varied character length for system-describing words—hashtags were added to shorter words (e.g., “#####UMNO#####”) so that they are the same length as the longest word (e.g., “transportation”).

Participants then completed the three-item system justification scale immediately after pupil size measurements, each time one of the four sub-systems was presented for response. Response were collected on a 5-point scale with the following anchors for: fairness (1 = *very unfair*, 2 = *somewhat unfair*, 3 = *neutral*, 4 = *somewhat fair*, 5 = *very fair*), functionality (1 = *it does not function as it should*, 2 = *it somewhat does not function as it should*, 3 = *neutral*, 4 = *it somewhat functions as it should*, 5 = *it functions as it should*) and, confidence in the relevant sub-system (1 = *I do not have confidence in this system*, 2 = *I somewhat do not have confidence in this system*, 3 = *neutral*, 4 = *I somewhat have confidence in this system*, 5 = *I have confidence in this system*). Finally, presentation of the four sub-systems was completely randomized to eliminate the possibility that the anticipated dissonance effects are loaded on the initial sub-system that was presented to participants for response.

A 6-item exit questionnaire measuring the *strength* of participants' ethnic identity, which we adapted from Luthanen and Crocker (1992) and, Owuamalam & Rubin, 2014 was completed after the manipulations and participants' system justification ratings: “I value being a Chinese”; “Being a Chinese is important to my sense of who I am”; “I am proud to be a Chinese”; “Being Chinese is a positive experience”; “It is important to me to be a Chinese” and “I am pleased to be a Chinese” (1 = *disagree completely*, 6 = *agree completely*, $\alpha = 0.93$). This identification scale was included towards the end, so that it did not contaminate an effect of the identity salience treatment on the dependent variable. On completing the experiment that lasted approximately 30–45 min, participants were rewarded with course credits/candies, thanked and debriefed.

6. Results

6.1. Data preparation

Pupil dilation data for the 4 systems were extracted for each participant and invalid data identified by the eye tracker as artefacts, including blinks and missing data, were discarded. This resulted in approximately 300–600 data units of pupil size scores for each participant and for each sub-system stimulus, for the left and right eyes. Pupil size data for the right and left eyes were aggregated for each sub-system stimulus and for each participant. We employed the same procedure to extract pupil sizes relating to the last word on the instruction slide, which we used as a *baseline* for calculating the relative pupil size changes for each of the four systems with the following formula:

$$p^* = \frac{(p - b)}{b}$$

where p^* is the normalized relative pupil size change estimate, p is the raw pupil size data for each system and b is the pupil size associated with the baseline. The last word on the instruction slide was used as the baseline because participants would not have started deliberations (requiring cognitive effort) prior to being shown the sub-system on which they were to provide an opinion (see Fig. 1 for experimental flowchart). Hence, the pupil should largely come to a resting position at the point where participants have just finished reading the instructions for the decision task that lay ahead. In short, any increases in pupil sizes

as participants contemplated their decisions beyond the baseline, reflects the cognitive effort expended during the decision task and these pupil size fluctuations were measured in millimeters. We combined the relative pupil size changes for high dependency sub-systems (healthcare and transportation) and low dependency sub-systems (MARA and UMNO), based on a confirmatory factor analysis showing that these item-pairs fit well together as theorized, $\chi^2_{(1)} = 1.10$, $p = .294$, CFI = 0.994, RMSEA = 0.027, SRMR = 0.021 (see Appendix A, Fig. A1 for factor loadings).

6.2. Self-reported system justification

For each of the four sub-systems, we combined participants' scores on the 3 dimensions of fairness, confidence and perceived functionality of the system. This procedure generated reliable scales of system justification for the four sub-systems, which were again combined to generate indices of system justification for high and low dependency sub-systems (see Table 2 for descriptive statistics and scale reliabilities).

6.3. Preliminary analysis

In line with SJT's system dependency caveat (and cognitive dissonance theory), we needed to show that pupil sizes and self-reported system justification were greater for high relative to low dependency sub-systems. Consistent with both perspectives, results from a paired t -test confirmed that participants exerted greater cognitive effort in justifying systems they were more rather than less dependent on (see Table 3).

6.4. Main analysis

Do the disadvantaged expend greater cognitive effort in justifying systems they are highly dependent on, when their group identities are relatively weak in salience/strength compared to the advantaged? SJT assumes that they do and, this is the basis for assuming the existence of an autonomous system justification motive. Hence, to compare this strong system justification thesis with the alternative prediction that we derived from cognitive dissonance theory, we ran a 2 (group status: disadvantaged vs. advantaged) $\times$ 2 (group identity salience: strong vs. weak) MANCOVA. In this analysis group identification (mean centered)² was also specified as a moderating covariate. Changes in pupil sizes for the high and low dependency sub-systems were entered in the model as the outcomes. Pupil sizes scores were transformed to normality using Templeton's (2011) 2-step transformation approach because they were highly positively skewed (see supplementary document [SOM-R], Table S1, for details).

Results revealed a multivariate group status $\times$ group identity salience interaction, Wilk's $\lambda = 0.927$, $F(2, 123) = 4.858$, $p = .009$, $\eta_p^2 = 0.073$. At the univariate level, the group status $\times$ group identity salience interaction³ significantly predicted the level of cognitive effort expended in justifying high dependency systems, $F(1, 124) = 9.708$, $p = .002$, $\eta_p^2 = 0.073$. Contrary to SJT, simple effect analyses revealed no significant difference in the level of cognitive effort expended to justify high dependency sub-systems amongst our ethnic Chinese participants who focused on their group's disadvantage ($M \pm SEM$; -0.509 ± 0.146) relative to their group's advantage

² A test of orthogonality between the manipulated and measured independent variables revealed that they were largely independent processes (full details are shown in our supplementary document, SOM-R).

³ Assuming an 80% power, an $\alpha = 0.05$ two-tailed, 4 groups of the 2×2 design, a post-hoc sensitivity power analysis suggests, that a sample size of ~130 cases has sufficient power to detect a critical F -value of 3.918; and an effect size of $f = 0.319$ for this key interaction. The observed F -values and effect sizes (f) for both studies were: Experiment 1 = [8.75 & 0.26] and for Experiment 2 = [5.36 & 0.21].

¹ In Experiment 2, we used a white slide with black ink.

Fig. 1. Experimental flow chart. Slide contents are approximations. Fixation crosses (+) were included in Experiment 2 but not Experiment 1. Slide backgrounds were dark grey in Experiment 1 but white in Experiment 2.

Table 2

Descriptive statistics for self-reported variables in experiments 1–2. ^{*}_p < .05, ^{**}_p < .01, ^{***}_p < .001.

	Experiment 1				Experiment 2			
	High dependency systems		Low dependency systems		High dependency systems		Low dependency systems	
	Transport	Healthcare	UMNO	MARA	Transport	Healthcare	UMNO	MARA
	<i>M</i> (<i>SD</i>) α	<i>M</i> (<i>SD</i>) α	<i>M</i> (<i>SD</i>) α	<i>M</i> (<i>SD</i>) α	<i>M</i> (<i>SD</i>) α	<i>M</i> (<i>SD</i>) α	<i>M</i> (<i>SD</i>) α	<i>M</i> (<i>SD</i>) α
System justification	3.04 (0.90) 0.79	3.30 (0.90) 0.85	1.85 (0.72) 0.72	2.03 (0.83) 0.77	3.48 (0.80) 0.79	3.54 (0.86) 0.85	2.07 (0.76) 0.81	2.34 (0.85) 0.82
System dependency					<i>M</i> (<i>SD</i>) <i>r</i> 4.13 (0.75) 0.65***	<i>M</i> (<i>SD</i>) <i>r</i> 3.99 (0.74) 0.49***	<i>M</i> (<i>SD</i>) <i>r</i> 1.97 (0.92) 0.50***	<i>M</i> (<i>SD</i>) <i>r</i> 1.70 (0.86) 0.49***

Note. *M* = mean, *SD* = standard deviation, α = Cronbach's alpha, and *r* = Pearson's correlation coefficient.

^{*} *p* < .050.

^{**} *p* < .010.

^{***} *p* < .001.

Table 3

Fluctuations in pupil sizes and self-reported system justification as a function of level of system dependency.

	Experiment 1					Experiment 2				
	System dependency		<i>t</i>	<i>p</i>	<i>d</i> _{Cohen}	System dependency		<i>t</i>	<i>p</i>	<i>d</i> _{Cohen}
	High	Low				High	Low			
Cognitive effort (Pupil size change)	0.205 (0.040)	0.026 (0.004)	4.489	< 0.001	0.391	0.100	0.258	−0.006 (0.007)	−0.113 (0.005)	15.500
Self-reported system justification	3.169 (0.061)	1.939 (0.059)	17.263	< 0.001	1.503	1.089	1.371	3.510 (0.055)	2.202 (0.055)	20.508

Note. Pupil sizes scores in Experiment 1 were non-normally distributed and, although the non-parametric Wilcoxon test (*W*) yielded a similar (albeit marginally significant) outcome, *W* = 5124.000, *p* = .066; a Bayesian pairwise contrast that quantifies the amount of evidence in support of the experimental hypothesis, revealed an “extreme” support for the observation that pupil sizes increase more for high (than low) dependency systems (BF10 = 948.859, error % = 8.912^{e-9}).

(−0.413 ± 0.144, *p* = .638, η_p^2 = 0.002, 95% CI = [−0.502, 0.309]) when their group identity was weakly salient. Interestingly, the predicted group status effect was, however, visible only when group identity was salient (see Fig. 2, see left panel solid data points): Here our ethnic Chinese participants expended greater cognitive effort to justify high dependency systems when they were focused on their group's disadvantage (0.851 ± 0.148) than their group's advantage (0.044 ± 0.144, *p* < .001, η_p^2 = 0.110, 95% CI = [0.398, 1.214]). The group status × group identification interaction was not significant (see Table 4 for full model results). A similar analysis that we conducted

with pupil size scores for low dependency sub-systems did not yield any significant main or interactive effects (see Table 4 and also Fig. 2, right hand panel). The outcome was largely similar when we used the raw untransformed data instead (see SOM-R, Table S2).

6.5. Exploratory analyses

SJT assumes that the decision to support societal systems (i.e. system justification) arises from cognitive dissonance, and that this is visible when group identities are weak in salience, especially amongst

Fig. 2. The effect of group status on pupil size fluctuations from the baseline when the salience of group identity was either strong or weak (Experiment 1). Error bars are 95% CIs.

Table 4

Univariate effects of group status, identity salience and group identification on pupil sizes.

	System dependency					
	High			Low		
	<i>F</i>	<i>p</i>	η_p^2	<i>F</i>	<i>p</i>	η_p^2
Experiment 1						
Group status (GS)	5.93	0.016	0.046	0.56	0.456	0.004
Identity salience (IS)	39.34	< 0.001	0.241	3.79	0.054	0.030
Group identification (ID)	0.07	0.798	0.001	0.01	0.945	< 0.001
GS*IS	9.71	0.002	0.073	0.84	0.361	0.007
GS*ID	0.02	0.883	< 0.001	0.47	0.494	0.004
Experiment 2						
Group status (GS)	0.46	0.501	0.004	0.04	0.848	< 0.001
Identity Salience (IS)	0.16	0.694	0.001	0.42	0.518	0.001
Group identification (ID)	1.53	0.219	0.012	0.18	0.676	0.001
GS*IS	0.28	0.597	0.002	0.73	0.396	0.006
GS*ID	5.36	0.022	0.041	3.12	0.080	0.024

Note. Analysis for Experiment 1 is based on the transformed data. Further analyses using untransformed pupil scores in Experiment 1 are presented in the supplementary document (SOM-R, Table S2). In Experiment 1, and for high dependency systems, changes in pupil sizes were larger in the disadvantaged condition (0.553 ± 0.030) compared to the advantaged condition (0.450 ± 0.030) and; pupil sizes were larger when group identity salience was strong (0.633 ± 0.030) rather than weak (0.370 ± 0.030). Also, in Experiment 2, the marginal effect of group identity salience on pupil sizes for low dependency system occurred because cognitive effort (pupil size) was greater when the salience of group identity was strong (0.554 ± 0.035) rather than weak (0.457 ± 0.035).

the disadvantaged. However, this crucial assumption has never been directly tested before, beyond the indirect test offered by Brandt (2013). Hence, to examine whether dissonance artefacts (i.e. indexed by cognitive effort) predict manifest levels of self-reported system justification, we performed pairwise Bayesian correlations between pupil

size increases and self-reported system justification for the high and low dependency systems across our experimental conditions. Contrary to SJT's dissonance-induced system justification assumption, results revealed no reliable correlation between changes in pupil size and self-reported justification of high and low dependency systems (see Table 5).

7. Discussion

Three key findings emerged from this study: a) greater cognitive effort was expended when justifying systems on which people were highly dependent and this outcome is consistent with both cognitive dissonance theory (Festinger, 1962) and system justification theory (Jost, 2017b; Kay et al., 2009); b.) the disadvantaged expended greater cognitive effort in justifying high dependency systems but only when their group identities were more (not less) salient and, this outcome is counter to the "strong system justification thesis" (Jost et al., 2003/2004) but supportive of cognitive dissonance theory. And; c) the cognitive effort expended to justify societal systems were not significantly related to participants' self-reported system justification and this outcome contradicts the system-justification theory because it shows that the experience of dissonance (quantified here as cognitive effort) does not necessarily predict support for the system in all instances. In short, whether system justification relates to self-reported reactions to inter-group hierarchies in which the ingroup is disadvantaged (as in Owuamalam et al., 2016, 2017; but see Jost's, 2019 argument against this approach) or to the cognitive effort expended to justify conventional systems (as depicted in pupil size fluctuations in the current study), the evidence seem to converge on the idea that a dissonance-induced system justification is plausible only when group identity is salient/strong rather than nonsalient/weak (see also Owuamalam et al., 2016).

7.1. Limitations

Firstly, it is possible to question the current results based on how difficult it is to be certain that the high and low dependency sub-

Table 5
Bayesian pairwise correlations between pupil sizes and self-reported system justification.

			Experiment 1				Experiment 2	
			Untransformed data		Transformed data		Untransformed data _a	
			<i>r</i> (BF ₁₀)	95% credible interval	<i>r</i> (BF ₁₀)	95% credible interval	<i>r</i> (BF ₁₀)	95% credible interval
Group disadvantage condition								
Strong identity salience	System dependency	High	0.06 (0.23)	−0.278, 0.378	−0.11 (0.26)	−0.424, 0.237	0.03 (0.21)	−0.288, 0.343
		Low	−0.22 (0.46)	−0.509, 0.125	−0.19 (0.36)	−0.479, 0.163	0.40 (3.21)	0.070, 0.624
Weak identity salience	System dependency	High	−0.29 (0.81)	−0.561, 0.055	0.22 (0.44)	−0.504, 0.131	9.30e-4 (0.23)	−0.343, 0.345
		Low	−0.21 (0.42)	−0.498, 0.139	0.12 (0.27)	−0.435, 0.225	0.01 (0.23)	−0.333, 0.355
Group advantage condition								
Strong identity salience	System dependency	High	−0.16 (0.32)	−0.459, 0.187	−0.13 (0.28)	−0.433, 0.217	0.03 (0.24)	−0.337, 0.385
		Low	0.22 (0.44)	−0.133, 0.502	0.02 (0.22)	−0.316, 0.352	−0.13 (0.29)	−0.459, 0.242
Weak identity salience	System dependency	High	0.27 (0.65)	−0.080, 0.542	0.24 (0.52)	−0.107, 0.522	−0.01 (0.21)	−0.317, 0.307
		Low	0.05 (0.22)	−0.288, 0.369	0.03 (0.22)	−0.304, 0.354	−0.17 (0.33)	−0.452, 0.158

Note. 95% credible intervals relate to the posterior distribution for the pairwise correlations. Pupil size scores in Experiment 2 were normally distributed and we did not transform these scores as a result. Data in bold represents 95% credible confidence intervals, which is roughly equivalent to $p < .050$.

* The transformed scores for self-reported endorsement of high dependency systems was used due to normality issues on this scale (see Supplementary Document, SOM-R).

systems were regarded as such by participants. Secondly, it is unwise to discard the system justification motive based on results from a single experiment, however compelling the evidence might seem. We therefore conducted a replication study to ascertain the reproducibility of the key results (cf. [Open Science Collaboration, 2015](#)). In doing so, we addressed the outstanding issue of whether participants themselves agreed with the distinction we make concerning the degree to which they are dependent on the four sub-systems used in the current investigation.

8. Experiment 2

8.1. Method

One hundred and thirty-one ethnic Chinese Malaysian participants took part in this study and they were recruited by a research assistant with an ethnic Malay background (86 were women, $M_{\text{age}} = 21.47$ years, $SD_{\text{age}} = 2.60$).

8.1.1. Procedure

This replication mirrored Experiment 1 as closely as possible with minor extensions: We additionally measured participants' views on how much they depended on the four sub-systems, and how important those systems were to them, in order to address the shortcomings in Experiment 1. Ratings were provided on a 5-point scale (for importance: 1 = *not important to me at all*, 5 = *very important to me*, for dependency: 1 = *I don't depend on it at all*, 5 = *I depend on it completely*).

As in Experiment 1, participants were all undergraduate students at a university in Malaysia and were randomly assigned to a 2 (group identity salience: strong, $n = 64$ vs. weak, $n = 67$) $\times$ 2 (group status: disadvantaged, $n = 66$ vs. advantaged, $n = 65$) between-subjects design. Group identification was measured as a continuous moderator as in Experiment 1 ($\alpha = 0.91$), while the dependent measures were pupil sizes that we recorded via the Tobii eye-tracker and participants' self-reported system justification. With respect to self-reported system justification scales, we took the opportunity to also include a fourth item concerning the perceived legitimacy of the 4 systems that participants rated (1 = *not legitimate at all*, 5 = *very legitimate*). All the other items on this system justification scale (including the fairness, confidence and functionality items) were rated on a 5-point Likert scale, which we

combined for each system type (see [Table 2](#) for descriptive statistics and scale reliabilities). Participants were paid RM5 as compensation for their time on completing the study and were thanked and thoroughly debriefed before exiting the lab.

8.2. Results

8.2.1. Preliminary analyses

We aggregated system dependency and system importance scores for each system cluster prior to entering these into a repeated ANOVA that also included group status as a between subject factor. This was done to be sure that the system dependency factor was necessarily independent from the group status manipulation, especially because some of the subsystems that used in the group status manipulation (e.g., UMNO and MARA), were also used to determine the level of system dependency. Results revealed a main effect of system dependence, $F(1, 129) = 989.68$, $p < .001$, $\eta_p^2 = 0.885$. Consistent with prior speculations in Experiment 1, participants agreed that they were more dependent on the high dependency sub-systems (4.059 ± 0.052) than the low dependency sub-systems (1.835 ± 0.057 , $p < .001$, 95% CI = [2.085, 2.364]). Hence, our distinction with regards to system dependency is supported by the evidence. Importantly, the main effect of system dependency was not further influenced by group status, $F(1, 129) = 1.902$, $p = .170$, $\eta_p^2 = 0.015$, demonstrating that these factors are independent, fulfilling an important assumption for using ANOVA to test the key predictions underlying this investigation.

Secondly, a repeat of the confirmatory factor analysis that we used to organize the pupil size scores in Experiment 1 revealed that a two-dimensional factor structure corresponding to high (healthcare and transportation) and low (MARA and UMNO) dependency systems best characterized our data, $X^2_{(1)} = 0.032$, $p = .859$, CFI = 1.00, RMSEA < 0.001, SRMR = 0.003 (see Appendix A, Fig. A2 for factor loadings). Hence, we proceeded to test SJT's system dependency caveat as we did in Experiment 1. Corroborating the evidence from Experiment 1, and consistent with both SJT and the alternative view dissonance thesis, paired t -test results confirmed that high (relative to low) dependency sub-systems elicited greater cognitive effort (see [Table 3](#)). In addition, and consistent with both theses, self-reported system justification was also greater for high (than low) dependency sub-systems (see [Table 3](#)).

Fig. 3. The effect of group status on pupil size fluctuations from the baseline when group identification was either strong ($M + 1SD$) or weak ($M - 1SD$; Experiment 2). Error bars are 95% CIs.

8.2.2. Main analyses

To compare the predictions from the strong version of the system justification thesis versus the alternative dissonance thesis, we again performed a 2 (group status: disadvantaged vs. advantaged) $\times$ 2 (group identity salience: strong vs. weak) MANCOVA. In this analysis, changes in pupil sizes relating to the two system types were specified as dependent variables, while group identification (mean centered) was included as a moderating covariate (see Table 4 for full model results). Results revealed a multivariate group status $\times$ group identification interaction, Wilk's $\lambda = 0.951$, $F(2, 124) = 3.219$, $p = .043$, $\eta_p^2 = 0.049$. At the univariate level, we observed a significant group status $\times$ group identification effect on pupil sizes relating to high dependency systems, $F(1, 125) = 5.36$, $p = .022$, $\eta_p^2 = 0.041$ (see Fig. 3). Conceptually replicating the patterns in Experiment 1, simple effect analyses revealed that when group identification was weak ($M - 1SD$), no visible difference emerged in the cognitive effort that participants expended to justify high dependency sub-systems across the two group status conditions (disadvantaged condition: -0.009 ± 0.015 versus advantaged condition: 0.015 ± 0.014 , $p = .245$, $\eta_p^2 = 0.011$, 95% CI = $[-0.063, 0.016]$). However, and corroborating the patterns in Experiment 1, greater cognitive effort was expended in justifying the high dependency systems when strongly identifying ($M + 1SD$) ethnic Chinese participants focused on their group's disadvantage (0.007 ± 0.014) relative to their group's advantage (-0.036 ± 0.014 ; $p = .036$, $\eta_p^2 = 0.035$, 95% CI = $[0.003, 0.082]$). The group status $\times$ group salience interaction was not significant and, there were no significant main or interactive effects for the low dependency system as in Experiment 1 (see Table 4, and Fig. 3).

8.2.3. Exploratory analyses

Like Experiment 1, we investigated whether dissonance artefacts (i.e., cognitive effort) predicted manifest levels of self-reported system justification amongst ethnic Chinese who focused on their group's disadvantage under varying salience of their ethnic identity. Corroborating the evidence from Experiment 1, results from a pairwise Bayesian correlation revealed that pupil size increments (cognitive effort) were unrelated to self-reported system justification for high

dependency systems (see Table 5). Interestingly, pupil size increments significantly predicted self-reported justification of low dependency systems amongst ethnic Chinese Malaysians who focused on their group's disadvantage. However, contrary to SJT, this happened when the salience of ethnic identity was strong and not when it was weak (see Table 5).

8.3. Discussion

The current findings provide a conceptual replication of the patterns reported in Experiment 1: Cognitive effort (in terms of pupil size increases) was greater amongst the disadvantaged when identification was strong (not weak) contrary to the system justification thesis, but supportive of the alternative view that we derived from cognitive dissonance theory.

It is important to note, however, that while all pupil size changes assumed a positive value in Experiment 1, the corresponding values for pupil size changes across most conditions in Experiment 2 were negative. It is tempting to interpret these negative values as evidence of pupil constriction. However, as Sirois and Brisson (2014, p. 681) have pointed out, results such as this are "likely due to luminance confounds, as psychological effects on pupil diameter are exclusively linked to dilation." Indeed, the degree of luminance in Experiment 2 ought to have been higher than it was in Experiment 1, due to the *white* stimulus slides used in that study. That is, a white slide could have increased screen brightness (and therefore luminance) much more than the *dark* stimulus slides that we had used in Experiment 1. Future investigation should avoid this oversight.

9. General discussion

The 25 years of research on system justification has witnessed extensive application of the system justification motive to the understanding of social, political, economic and psychological issues despite the controversy surrounding its existence (Owuamalam, Rubin, & Issmer, 2016; Owuamalam, Rubin, & Spears, 2016; Owuamalam et al., 2018a, 2018b, 2019a, 2019b). This motivation is predicated on the

crucial, but largely untested assumption that the “strongest, most paradoxical” form of system rationalization processes (and the one most distinct from predictions derived from other theories) can be gleaned via the *cognitive effort* that the disadvantaged expend in justifying those systems on which their livelihoods depend, especially when their group identities are also weak in salience or strength (Jost et al., 2004; p.909). Using a novel pupil dilation paradigm to tap cognitive effort, we found that the disadvantaged did not expend greater cognitive effort in justifying high dependency systems either when their group identity was weak in salience (Experiment 1) or when the strength of their group identification was weak (Experiment 2). In fact, cognitive effort was more reliably visible in the disadvantaged (relative to the advantaged) condition, when group identity was salient (Experiment 1) or when group identification was strong (Experiment 2), consistent with the alternative predictions inspired by the original statements of the cognitive dissonance theory (Festinger, 1962; see also Owuamalam, Rubin, & Issmer, 2016, Owuamalam, Rubin, & Spears, 2016; Owuamalam et al., 2018a, 2018b, 2019a). These results provide disconfirmatory evidence for the existence of an autonomous system justification motivation, at least as currently theorized (cf. Jost et al., 2003, Jost et al., 2004).

Furthermore, the fact that increased cognitive effort predicted greater self-reported system justification in the disadvantaged condition in one out of eight conditions across two experiments, suggests that system justification might not be the ‘default’ outcome of cognitive dissonance, and this evidence should inform future theorizing around the system justification effect. Accordingly, it is encouraging that recent revisions of the system justification thesis now seem to de-emphasize the dissonance-inspired strong diagnostic version of the system justification thesis. As Jost (2019, p.282) explains:

It is important to keep in mind, however, that Jost et al. (2003) explicitly pointed out that “economic and other theories of material and symbolic self-interest may be said to account for the ‘baseline’” [i.e. system justification] (p. 14) and emphasized that... [system justification scholars] *never regarded dissonance reduction as the ‘engine’ of system justification* (our emphasis).

The current findings agree with the foregoing statements, showing that social identity motives can explain system justification, if cognitive conflict plays a role in this process at all, because the dissonance effects that did emerge, occurred either when group identity was salient (Experiment 1) or when group identification was strong (Experiment 2).

But, Jost’s (2019) clarification raises further issues that future research could aim to resolve. Firstly, assuming the dissonance-inspired system justification thesis is no longer the ‘engine’ or litmus test for the existence of the system justification motive, then how can the existence of this new and autonomous motive be determined? Secondly, a number of processes assumed to underlie the system justification motive are also linked to cognitive dissonance and by extension to personal interests (e.g., the need for cognitive consistency, the need to reduce uncertainty or even to manage threat; see Owuamalam et al., 2019b, p. 404). It is unclear what becomes of these add-ons (and consequently the system justification theory itself) if the cognitive dissonance-inspired thesis of SJT is discarded. Hence, a challenge for researchers is to untangle the *autonomy* of the system justification motivation from motives that are rooted in personal and collective identities (see also Owuamalam et al., 2019a, 2019b).

9.1. Limitations

Although the primary group status by identity salience/strength interaction was conceptually replicated across the two experiments, we

acknowledge that differences exist. For example, the identity salience x group status effect on pupil diameters occurred in Experiment 1, but was absent in Experiment 2, while the conceptually similar group identification x group status effect was only found in Experiment 2 but not Experiment 1. Why might this be so? It is important to note that Experiment 1 was administered by an ethnic Chinese research assistant (ingroup), and Experiment 2 was administered by a Malay research assistant (outgroup). A series of studies in the intergroup literature show that social identities become more salient when people are placed in a context comprised of outgroup members (Owuamalam & Rubin, 2014; Wigboldus, Spears, & Semin, 2005). It is possible, therefore, that this change could have intensified the salience of our Chinese participants’ ethnic identity before a Malay experimenter, which could have diluted the potency of the identity salience treatment in Experiment 2. Also, the fact that the group identification x group status interaction emerged only in Experiment 2 that was conducted by an outgroup (Malay) research assistant suggests that a *competitive* context (e.g., the presence of an outgroup) may be necessary to provoke the identification effects that was recorded in that study. This competitive context was largely absent in Experiment 1 that was conducted by an ingroup (Chinese) research assistant and this might explain the lack of group status x group identification interaction in that study. Also, if the experimenter’s identity did raise the salience of group identity across conditions in Experiment 2, the onus of finding the dissonance effects may have shifted to identification (i.e. amongst high identifiers). Put differently, when the salience manipulation was stronger (Experiment 1) this might have overshadowed conceptually similar effects of identification. Such possibilities remain speculative so future research could investigate this further.

A key strength of the current investigation was the use of an existing social group that more credibly represented the intended phenomena in the real world. But it also presented challenges with regards to differentiating SJT’s system dependency assumption (Jost, 2017b; Kay & Zanna, 2009) from its legitimacy assumption (Jost, 2012). It is entirely possible that the high dependency systems are also systems that could be perceived as high in legitimacy by our participants because the Chinese enjoy the benefits of the Malaysian healthcare and transportation systems as well as any other Malaysian ethnic group. Likewise, it is possible too that the low dependency systems (i.e. MARA scholarship and UMNO political systems) can be seen by ethnic Chinese Malaysians as being largely illegitimate because benefits from these systems are less open to their ethnic group than to others (e.g. the Malay majority ethnic group). So, although there was evidence that the high and low dependency systems were perceived as such, it was not possible to completely rule out a legitimacy-based explanation for the effects reported here because high dependency systems are also high in legitimacy and low dependency systems are low in legitimacy. In fact, an analysis of participants’ self-reported legitimacy in Experiment 2, confirmed that high dependency systems (transportation and healthcare) were seen to be more legitimate (3.538 ± 0.063) than low dependency systems (MARA and UMNO; 2.405 ± 0.069 , $p < .001$, 95% CI = 0.962 , 1.306).

Nonetheless, there is at least one reason why this confound does not undermine the current test of the strong system justification thesis. The confound-to-treatment pairing with regards to legitimacy and dependency were congruent with SJT’s proposition because the theory requires both dependency and legitimacy to be high and, these conditions were met across the two studies. Hence, the legitimacy confound actually created a maximal condition to confirm the strong system justification thesis. The lack of support for the theory, even in this optimal condition, raises important questions that researchers should address.

It is also possible to argue that the pupil modulations in this study represent evidence that system justification operates at the unconscious level—even if they did not occur in the conditions proposed by SJT—because such reflexes are essentially automatic, and theorists have often equated nonsconscious awareness with automaticity (Jost et al., 2004, p. 894; see also cf. Jost, 2017). Indeed, Owuamalam et al. (2018a) have argued that a dissonance-induced system justification is unlikely to manifest at the nonconscious level (see also Gawronski & Strack, 2004), because this seems to contradict the classical dissonance theory prediction that the conflicting elements should be salient (as supported here). However, we would like to point out that although the pupillometric methodology we use here taps into an *automatic* process in key respects, this does not mean that this is unconscious in terms of *awareness*, primarily because the deliberations that gave rise to this automatic process were arguably based on a conscious awareness. As Bargh (1994) points out, it is important to distinguish *conscious awareness* (here deliberations of competing ‘salient’ realities) from *responses* that are efficient, unintentional and beyond control (together the so-called four horsemen of automaticity). In short, our methodology arguably allows for conscious awareness but rules out conscious control.

9.2. Theoretical opportunities

A strength of the system justification thesis, some might say, is the auxiliary proposition that system justification is most likely to manifest when the system is perceived to be legitimate because it should be easier to confirm that people (especially the disadvantaged) accept and/or support societal systems that are legitimate than those that are not (Jost et al., 2012). But, assuming legitimization is a form of system justification, as consensually accepted by researchers (e.g., Brandt, 2013; Jost & Hunyady, 2005; Jost, 2019; Sengupta, Osborne, & Sibley, 2015), then the foregoing caveat seems tautological because, it implies that people *legitimize* systems that are already *legitimate*. A further complication of the legitimacy caveat is that it leads to the prediction that ‘settled’ (i.e., accepted) realities produce the greatest uncertainties and/or dissonance than questionable/illegitimate regimes. In the current investigation, the legitimacy caveat ought to have manifested through a dissonance-induced *self-reported* justification of the more legitimate transportation and healthcare systems amongst the disadvantaged. But, the evidence from Experiment 2 suggests the opposite pattern. A dissonance-induced self-reported justification of social systems emerged only for those systems that might be perceived to be relatively less legitimate (MARA and UMNO, see Table 5), and it would have been difficult to demonstrate this directly without a process tracing pupillometric approach.

Indeed, the foregoing evidence makes sense, in retrospect, because it suggests that systems that are *already* legitimate (or at least perceived as such) are unlikely to provoke as much agitation about one's group's interests as perhaps an illegitimate order might do. That such an effect occurred in the context of systems that are less legitimate suggests that in this situation, people may be most motivated to quell associated uncertainties by clinging to the devil they know (i.e. regimes they are already familiar with). This position is similar to Kay and Zanna's (2009) system inescapability-induced rationalization argument, in the sense that constantly dwelling on one's undervalued position in an illegitimate order can be expected to undermine the wellbeing of the disadvantaged (Owuamalam, Paolini, & Rubin, 2017; Owuamalam & Zagefka, 2013). A temporary *fix* might be to accept such regimes,

especially if there is also hope that ingroup's concerns can be addressed within the prevailing order in the long-run (Owuamalam et al., 2018b, 2019a, 2019b). Having said that, this new hybrid illegitimacy- cum dissonance-induced justification has not been exhaustively tested and, the novel process tracing method that we describe here (i.e. pupillometric reflexes) could be a particularly useful tool in this endeavour. Future probes into this hybrid proposition may also present the opportunity to bridge the theoretical gap between SJT and cognitive dissonance, if only the strong system justification thesis is relaxed somewhat. But if the strong system justification thesis is discarded, then there is no further basis for an autonomous system justification motivation, and then the system justification perspective would cease to offer a unique insight into human behavior beyond existing frameworks, such as the social identity theory (Tajfel & Turner, 1979; see also the social identity model of system attitudes, Owuamalam et al., 2018b; Owuamalam et al., 2019a, 2019b).

10. Concluding remarks

Does an autonomous system justification motive exist in humans? The diagnosis for this special motive lies in providing supportive evidence for the strong system justification thesis. This thesis proposes that a dissonance-induced system rationalization will occur amongst the disadvantaged as they contemplate their support for societal systems, but only when the salience of their group identity is weak (e.g. non-salient), or when their group identification is weak. However, pupillometric reflexes that are traditionally used to capture dissonance effects were unable to detect the system motive in those conditions that are presumed to be optimal in activating it according to SJT. If anything, the trend in pupillometric reflexes across Experiments 1 and 2, were more consistent with cognitive dissonance theory (Festinger, 1962) and emerging interest-based accounts of system justification (e.g., Owuamalam, Rubin, & Issmer, 2016; Owuamalam et al., 2017; Owuamalam et al., 2018a, 2018b; Owuamalam et al., 2019a, 2019b), in so far as the dissonance-effects were most visible when the elements involved (the system vs. group identity) were important and salient in people's minds. Nevertheless, that we found negative results for the strong system justification thesis is not necessarily a bad thing, because it underscores the need for precision and reform in social psychological theorizing prior to an application attempt. Reforming the system justification theory in light of accumulating unsupportive evidence may involve discarding its strong version. But, abandoning the strong system justification thesis also removes the basis for SJT's foundational proposition that an *autonomous* system motive that guides human behavior exists.

Open practices

Experiments 1 and 2 were not formally pre-registered (although the arguments have already been presented in a prior publication Owuamalam, Rubin, & Spears, 2016, *Frontiers in Psychology*). The study materials, analysis scripts (e.g., SPSS syntax) and associated data, can be accessed in OSF via <http://tiny.cc/14wacz>. We did not collect any more data after analysis.

All research and procedure reported received approval from the Science and Engineering Research Ethics Committee at the University of Nottingham in Malaysia, and followed the ethical guidelines of the British Psychological Association for the conduct of research with human participants.

Appendix A

Fig. A1-2. Confirmatory factor structure concerning pupillometric measurements for high and low dependency systems in Experiments 1 (A1) and 2 (A2).

Appendix B. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jesp.2019.103897>.

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