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THEORETICAL REVIEW

Self-face advantage over familiar and unfamiliar faces: A three-level meta-analytic approach

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Abstract
Despite the increasing number of researchers interested in self-face, so far, no study has summarized the behavioral findings that contribute to the debate on self-face advantage. Most studies have focused on neural correlates of the self, although functional uniqueness can also be considered an important criterion for determining whether a stimulus is unique. The present meta-analysis systematically compared reaction time (RT) responses for self-face with other face identities across 54 studies. Different moderator factors were tested: familiarity, identity, head angle, laterality, and culture. We used a three-level meta-analytic approach, which is the best approach to account for the dependency of effect sizes. Results showed a significant (Hedges's $g_{av} = -0.298$) effect size, indicating faster RT for self-face than for other faces in general. Except for culture, none of the moderators employed significantly impacted on the main effect. Regarding culture, results showed that participants from Western cultures tend to respond faster to their own face than to other people's faces, while for participants from Eastern cultures, the effect was not significant. In summary, our results indicate that the self-face benefits from an advantage in terms of reaction time and may be considered a unique stimulus. Implications and limitations of the results are discussed.

Keywords Face recognition · Self-face · Self-advantage · Reaction time · Meta-analysis

Every morning, most people look in the mirror to check their appearance. Every time we look in the mirror, we know we are looking at ourselves. The self-face has a special meaning to humans due to its uniqueness and its importance for our identity and our sense of self. Looking at ourselves in the mirror gives us access to our own image, as well as to proprioceptive, tactile, and motor sensory cues, which enables individuals to update their mental representation of their own face (Tsakiris, 2008). Contrary to other self-related information, our own face is a unique stimulus, since we do not share it with other people (Devue & Bredart, 2008). Therefore, it has an important value for our own sense of identity and also constitutes one of the main components of our official identity, as we can observe through identity cards, passports, and driving licenses.

The interest in studying self-face processing emerged mainly from the studies conducted by Gallup and colleagues in chimpanzees. In a series of studies using the mark test, Gallup (1977) suggested that chimpanzees were able to recognize their own image. Almost concomitantly with Gallup's studies, Amsterdam also used the mark test (or mirror self-recognition task) to investigate children's responses to a mirror (Amsterdam, 1972). Indeed, the ability to recognize oneself is not an innate ability but develops gradually (Courage, Edisona, & Howeb, 2004), probably in a series of stages (Rochat, 2003). It is suggested that humans are able to recognize their own image in a mirror around the second year of life. Nevertheless, it is only later that infants develop the ability to recognize themselves in pictures and videos (Rochat, 2003). Studies have also suggested that being able to recognize oneself implies a symbolic representation of the self (the ability to perceive oneself as someone who has an outside appearance) and, consequently, the representation of others, allowing the self-other distinction (Rochat, Broesch, & Jayne, 2012).

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Although the mirror self-recognition task is frequently mentioned as the “gold standard” for measuring visual self-recognition, more recent studies have mainly used images displayed on computer screens. When researchers explore self-face recognition, one of their main goals is to better understand the self as a whole and thus determine which aspects make the self a unique stimulus. On a more theoretical level, the question of whether the self-face can be considered as a unique stimulus with specific properties is still a matter of debate. As several lines of research have shown, self-relevant stimuli are processed faster and more accurately than other types of stimuli. For instance, self-face processing has been suggested to differ from other faces (both familiar and unfamiliar) in terms of behavioral, neural and neurophysiological responses (e.g., Devue & Bredart, 2011), although not all researchers seem to agree (Gillihan & Farah, 2005). For instance, Gillihan and Farah (2005) found no consistent evidence supporting a physical or psychological self as being unique. Regarding the self-face, they stated that evidence is mixed and yielded inconsistent results regarding anatomical localization for self-face recognition.

Previous reviews on this topic have mainly focused on the neuroanatomical aspects of the self (Devue & Bredart, 2011; Platek, Wathne, Tierney, & Thomson, 2008). Nevertheless, another criterion that can be used to determine whether a stimulus is unique is to look at its functional uniqueness, that is, whether the stimulus is processed in a unique way. For this, it would be necessary to consider the behavioral studies performed in the domain. Surprisingly, at behavioral level, no study has yet tried to summarize and statistically test whether self-face is really a unique stimulus associated with specific mechanisms. One of the criteria often employed to determine whether self-face processing is unique (or has a unique meaning for individuals) or not relates to reaction time, that is, whether or not self-face is prioritized and processed faster in comparison with other faces. Although several studies argue that the self-face is a unique stimulus and that individuals respond faster to their own face, current evidence reveals contradictory results. Crucially, several factors might be associated with these contradictory results, notably, methodological and sample related factors. In an attempt to explain heterogeneity and understand the potential effect of experimental and individual factors on self-face recognition, we considered different moderators.

Moderators

First, we considered the fact that studies included different stimuli. Self-face processing has been compared with the processing of unfamiliar (Hughes & Nicholson, 2010), famous (Tacikowski & Nowicka, 2010), and familiar faces such as friends (Sugiura et al., 2006; Sugiura et al., 2005), family members (Martini, Bufalari, Stazi, & Aglioti, 2015), colleagues (Liew, Ma, Han, & Aziz-Zadeh, 2011), or a partner (Kircher et al., 2000). There is consistent evidence suggesting different mechanisms involved in processing familiar and unfamiliar faces (Burton, Jenkins, & Schweinberger, 2011; Natu & O’Toole, 2011). The differences between familiar and unfamiliar faces include (1) the type of information extracted from the faces (identity-specific semantic codes for familiar faces only vs. visually derived semantics for both unfamiliar and familiar faces; Bruce & Young, 1986); (2) the amount of exposure we have to one particular face, which is associated with the robustness of familiar face representations and with the fact that familiar faces are more tolerant to changes in pose or expressions compared to unknown faces (Burton et al., 2011; Jenkins & Burton, 2011); and (3) the emotional aspects that are associated with the recognition of a familiar face (Gobbini & Haxby, 2007; Gobbini, Leibenluft, Santiago, & Haxby, 2004). In view of the arguments described above, three initial moderators were considered. First, the level of familiarity, that is, whether the face was familiar or not to the participants (*familiarity*). Second, the identity of the face, whether it belonged to someone she or he knows personally, whether it was a famous person or a stranger (*identity*). Third, we also considered whether the face was presented in “profile” view or “frontal” view (*head angle*), since a better mental representation of familiar faces may prompt individuals to recognize them faster than unfamiliar faces, especially in profile view (e.g., Tong & Nakayama, 1999). We also considered the interaction between familiarity and head angle.

The task employed and, more precisely, the cognitive function on which that task relies may also have an impact on self-face processing. Some tasks request participants to identify and/or recognize some stimulus properties such as identity or head orientation, while others request participants to detect or search for a specific stimulus property. Thus, while the first may rely more on memory or perceptual functions, the later depends mostly on attention resources. Therefore, tasks may be classified according to whether they request participants to rely more on pictorial/perceptual information (e.g., head angle or static pose) or semantic information (e.g., face identity or level of familiarity). Although the extraction of semantic information also takes place during attentional tasks or perceptual tasks, since we automatically attach meaning to what we are seeing, the task itself does not require the extraction of this information to be successful. Therefore, the fourth moderator considered in the present study is *type of task.*

Some authors have suggested that whether participants perform the task using the left or right hand may also impact on the self-face advantage. In fact, some studies investigating face found a right-brain hemisphere advantage for self-face processing (Keenan, Freund, Hamilton, Ganis, & Pascual-Leone, 2000; Keenan, Ganis, Freund, & Pascual-Leone, 2000; Keenan et al., 1999; Keenan, Nelson, O’Connor, &

Pascual-Leone, 2001; Keenan, Wheeler, Platek, Lardi, & Lassonde, 2003; Keenan, Wheeler, Gallup, & Pascual-Leone, 2000). However, some evidence also points towards a left-brain hemispheric advantage (Turk et al., 2002; Uddin, Rayman, & Zaidel, 2005) or no hemispheric advantage (Keyes & Brady, 2010). Therefore, the fifth moderator considered is *laterality.*

The last moderator considered is *culture.* There is consistent evidence suggesting that the self-face does not have the same importance across different cultures (Broesch, Callaghan, Henrich, Murphy, & Rochat, 2010). A greater self-face advantage for British than for Chinese subjects has been described (Sui, Liu, & Han, 2009). It has been proposed that Western cultures are known to be more individualistic and characterized by an independent self-construal, while Eastern cultures are characterized by an interdependent self-construal.

Method

Inclusion criteria

Studies were eligible for inclusion if they met the following criteria:

1. The study included healthy individuals between 18 and 60 years of age.
2. The study used an experimental design measuring self-face processing during an implicit or explicit self–other processing (i.e., face-recognition task, face-familiarity task, visual-search task, video-morphing task, self–other discrimination, head-angle task).
3. The dependent variable consisted of behavioral measures, more specifically, reaction time or a similar measure indicating time to respond, or the amount of information needed to make a choice and decide that the information belongs to oneself or someone else (e.g., percentage in a morphing continuum). Accuracy was not included since most studies report ceiling effects for self-face and familiar-face recognition, thus making comparison impossible.
4. Studies included the face as stimulus. That is, participants had to implicitly or explicitly respond to the image of their own face compared with someone else's face.
5. Studies included someone else's face to contrast with the self-face processing. The other face might be a familiar, friend's, famous, or any other known or unknown face.
6. The contrast between self–other faces was assessed and tested through a within-subject design.
7. Selected studies included sufficient data for the calculation of Hedges's g_{av}, or authors were able to provide additional data when required. When data were not available, authors were contacted twice in an attempt to obtain more information.

Exclusion criteria

Studies meeting the following criteria were excluded:

1. Studies including only participants suffering from a psychiatric disorder or any neurological disorder.
2. Studies reporting only accuracy, neuroimaging, neurophysiological, or physiological data or self-reported measures.
3. Studies employing tasks of priming effect, double task, or interference task.
4. Studies employing visual-search paradigms in which the self-face was a distractor (since the self-face seems to hold attention longer than others' faces, it interferes with the response to unknown faces; Devue, Van der Stigchel, Bredart, & Theeuwes, 2009).
5. Studies that do not evaluate the direct comparison between self–other processing.

Literature search strategy

To identify relevant articles, we first carried out an online search of the PsychINFO, and Medline databases up to December 2016 using the two main keywords *self-face* OR *own face* OR *self-recognition*. We did not add other keywords to further describe the type of task, measure, or participants in order to avoid excluding eligible studies. We searched for studies that evaluated self-face processing (implicit or explicit) in contrast to other-face processing. Second, we also searched Google Scholar citations of the articles included as well as unpublished studies, dissertations, and conference papers. Third, in the reference list of studies was scrutinized for studies not included in the electronic database. Fourth, theses and dissertations and other unpublished works were also searched for in OATD (Open Access Theses and Dissertations), ProQuest, and the ERIC index. Fifth, we sent requests via newsgroups and mailing lists to find unpublished studies (i.e., Society for Experimental Psychology and Cognitive Science, Society of Experimental Social Psychology). Sixth, the first author of the present article requested relevant unpublished research as a question topic on her Research Gate webpage. Finally, researchers whose articles were retrieved for inclusion were contacted by email as well as those with incomplete data. As a result of these efforts, we retrieved one unpublished thesis (two studies; three experiences; five effect sizes) and another partially published thesis, meaning that the author published the data of fewer participants than what was available in the thesis. Therefore, the final data set included a small subset of unpublished research.

Screening for eligible studies

The search resulted in 340 studies from PsycINFO, 280 additional studies from Medline, 244 studies from ProQuest, and

91 from the ERIC index, resulting in a total of 955 studies (see Fig. 1). Researchers also searched Google Scholar citations of the articles included as well as unpublished studies, dissertations, and conference papers. Two independent researchers analyzed the articles, and any disagreements were discussed. After reviewing the articles' abstracts (Step 1), 212 studies were initially included. Subsequently, articles' abstracts were analyzed, and 121 met our inclusion criteria. In Step 2, researchers read the full article. In the end, 62 were eligible to for inclusion. We analyzed these studies in order to determine whether they included enough information to calculate the effect size. Of these 62 studies, 21 studies lacked sufficient information, and 1 study lacked part of the data. We obtained additional data from the authors for seven of them. This resulted in the exclusion of 14 studies from the meta-analysis. Two studies reported data from the same sample. Thus, in total, 48 studies were included involving 54 samples and 116 effect sizes. Information regarding the processes of coding the studies is present as Supplementary Materials.

Meta-analytic procedures

To analyze the differences between self-face and other-face processing in terms of reaction time, we conducted analyses by calculating an effect size, namely, Hedges's g_{av}, the standardized mean difference in reaction time between the self-face- and other face, as recommended by Lakens (2013). Negative effect sizes indicate favorable reaction time for self-face compared with other face (for more information on effect-size calculation, please refer to the Supplementary Materials). Most studies investigating self-face recognition in contrast to the recognition of other people's faces have generated multiple effect sizes per study. Thus, it is very likely that the effect sizes from the sample studies are more alike compared with effect sizes from different studies. In other words, our meta-analysis included nonindependent effect sizes. Nevertheless, traditional univariate meta-analytic approaches require no dependency between effect sizes. Consequently, we employed a three-level meta-analytic approach (Cheung, 2014; Hox, 2010), which is the best approach to account for the dependency of effect sizes. This approach takes into consideration three sources of variance: the sampling variance of the extracted effect sizes (Level 1), the variance between effect sizes extracted from the same study (Level 2), as well as the variance between studies (Level 3). Thus, we can analyze both differences in outcomes between studies (between-study heterogeneity) and within studies (within-study heterogeneity). The analyses were conducted with the rma.mv function of the metafor package (Viechtbauer, 2010) in the R statistical software environment (R Development Core Team, 2005) by using guidelines formulated by Assink and Wibbelink (2016) for modeling a three-level random-effects model as described by Van den Noortgate, López-López, Marín-Martínez, and Sánchez-

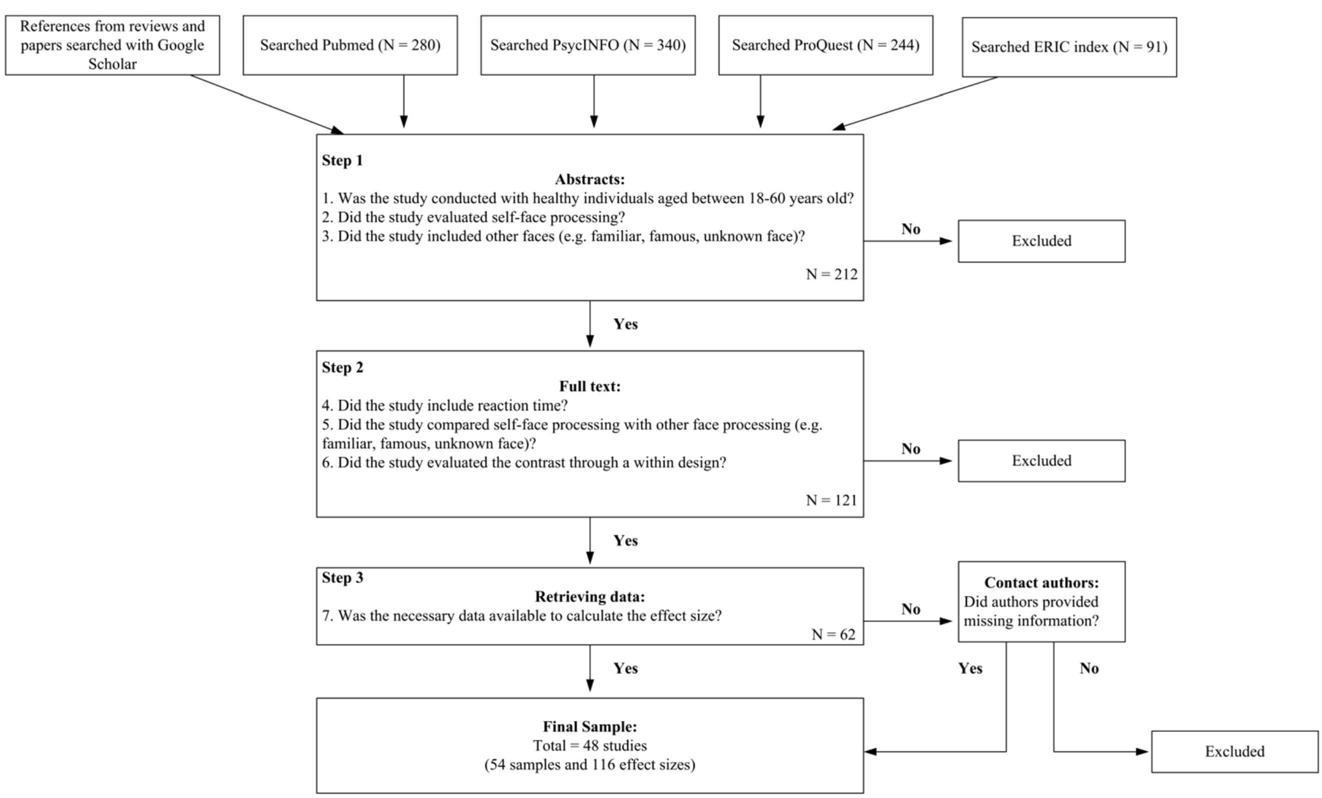

Fig. 1 Flowchart of literature search and screening

Meca (2013). For more information regarding data analysis, please refer to the Supplementary Materials (Table 1).

Results

Characteristics of the studies included

Fifty-three samples from the 48 articles were included in the study, representing 116 effect sizes. In total, 1,299 adults were included in the study. Table 2 summarizes the characteristics of the studies evaluating self-face processing. More information regarding the studies included in the meta-analyses can be found in Table S1 in the Supplementary Materials.

Meta-analysis results

Overall effect The overall average effect size of the contrast between self-face and other-face processing (including familiar, famous, and unknown) was −0.346 (95% CI [−0.484, −0.207], $p < .001$) indicating faster responses to self-face than to other people's faces, which was, however, small. There was evidence of heterogeneity among the studies, $Q(114) = 1127.257$, $p < .001$.

Heterogeneity in effect sizes

Significant heterogeneity both at Level 2 within study ($\sigma^2 = 0.094$, $\chi^2 = 95.217$, $p < .001$) and Level 3 between study ($\sigma^2 = 0.176$, $\chi^2 = 47.042$, $p < .001$) was observed. Variance at Level 3, Level 2, and Level 1 explained, respectively, 60.27% (moderate heterogeneity), 32.04% (low to moderate heterogeneity), and 7.68% of the overall variance.

Table 1. Summary of the coding system

Variable	Levels
Familiarity	Familiar (personally familiar and famous persons) Unfamiliar faces
Identity	Personally familiar faces Famous faces Unfamiliar faces.
Head angle	Only front view Both front and profile views
Type of task	Memory based Identification tasks (e.g., familiarity judgment) Perception-based Identification tasks (e.g., head-orientation task) Attention-based tasks (e.g., visual-search paradigm)
Laterality	Right (hand or visual field) Left (hand or visual field) No effect tested
Culture	Eastern culture Western culture

Egger's intercept and sensitivity analysis

Egger's intercept (intercept = 0.989, $t = 5.347$, $p = .0001$) appeared significant, indicating that the precision and size of studies included in the data set was considered asymmetrical, and therefore, biased. As mentioned before, we searched for influential outliers in order to evaluate the sensitivity of our analyses by comparing fitted models with and without effect sizes that we defined as influential outliers. Nevertheless, our results did not detect influential outliers in any of the data sets.

Moderating analysis

The following categorical variables were considered in the moderating variables: (1) familiarity (familiar vs. nonfamiliar); (2) identity (personally familiar, famous, and unknown); (3) head angle (profile vs. front face); (4) type of task; (5) laterality in terms of hand employed or visual field presentation (left, right, or no effect tested); (6) and culture (Eastern vs. Western).

Familiarity (familiar vs. unfamiliar)

No significant effect was observed when considering the moderator familiarity, $F(1, 113) = 1.368$, $p = .245$, indicating that participants responded faster to their own face in contrast to both unfamiliar ($g_{av} = -0.406$, $SE = 0.087$, $t = -4.662$, $p = .001$) and familiar ($g_{av} = -0.313$, $SE = 0.075$, $t = -4.149$, $p = .001$) ones.

Identity (personally familiar, famous, and unknown)

The effect of the moderator *identity* was not significant, $F(2, 112) = 0.800$, $p = .452$, indicating that the participants responded faster to their own face than to unknown faces ($g_{av} = -0.409$, $SE = 0.088$, $t = -4.673$, $p < .001$), faces belonging to personally familiar faces such as friends and relatives ($g_{av} = -0.312$, $SE = 0.086$, $t = -3.640$, $p = .001$) as well as famous faces ($g_{av} = -0.304$, $SE = 0.113$, $t = -2.682$, $p = .008$).

Head angle

No significant differences were found when considering the moderator effect of head angle, $F(1, 113) = 0.920$, $p = .340$. This result indicates that participants responded faster to their own face than to other people's faces regardless of whether faces were presented only in frontal view ($g_{av} = -0.302$, $SE = 0.083$, $t = -3.620$, $p = .001$) or in profile/frontal view ($g_{av} = -0.431$, $SE = 0.113$, $t = -3.804$, $p = .001$).

Interaction between familiarity and head angle

The effect size of each type of task indicated that when performing a task involving attentional processes (e.g., visual search task), participants responded with similar speed to their

Table 2 Characteristics of the samples included in the studies investigating self-face processing

	Study	Culture	*N*	Task	Identity	Face view	Laterality	Results
1	Bortolon, Capdevielle, Salesse, & Raffard, 2015	WC	23	Face recognition	Famous and unknown	Frontal view	Both hands	SF = FFa / SF = UF
2	Bortolon, Lorieux, & Raffard, 2017	WC	40	Delayed matching face	Familiar (friend), famous and unknown	Profile/frontal view	Both hands	SF = FF < FFa < UF
3	Butler, Mattingley, Cunnington, & Suddendorf, 2013	WC	20	Face recognition	Familiar (siblings) and unknown	Frontal view	Right Only	SF = UF = UF
4	Cygan, Tacikowski, Ostaszewski, Chojnicka, & Nowicka, 2014	WC	23	Face detection task	Three kinds (Familiar: parents, siblings or partner)	Frontal View	NK	SF = FF = FFa = UF
5	Heinisch, Wiens, Grundl, Juckel, & Brune, 2013	WC	19	Video morphing	Famous and unknown	Frontal view	NK	FF = SF < UF
6	Hong & Hongxiao, 2014	EC	21	Self-other discrimination	Famous and unknown	Frontal view	Alternatively right or left	SF/FFa < UF
7	Hu, Liao, Luo, & He, 2013	EC	32	Self-other discrimination	Familiar, famous and unknown	Frontal view	NK	SF = FF < FFa < UF
8	Hughes et al., 2010	WC	91	Self-other discrimination	Unknown	Frontal view	Alternatively right or left [b]	SF > UF
9	Irani 2008	WC	21	Face recognition	Familiar (parents) and unknown	Frontal view	Alternatively right or left [b]	SF = FF / SF = UF
10	Keenan et al., 2000	WC	10	Self-other discrimination	Familiar (co-worker) and famous	Frontal view	Alternatively right or left	SF = FF
11	Keyes et al., 2010	EC	26	Face recognition	Familiar (friend) and unknown	Frontal view	Alternatively right or left [b]	SF < FF < UF
12	Kircher et al., 2000	WC	6	Self-other discrimination	Familiar (partner) and unknown	Frontal view	Both hands	SF = FF/UF
13	Kircher et al., 2001	WC	20	Familiarity judgment	Familiar (partner) and unknown	Frontal view	Both hands	SF = FF[a]
14	Kita et al., 2010	EC	22	Video morphing	Famous and unknown	Frontal view	Right Only	SF = FFa/UF
15	Kotlewska et al., 2015	WC	25	Detection task	Familiar, Famous and Unknown	Frontal View	NK	SF = FF = FFa = UF
16	Lee, Kwon, Shin, Lee, & Park, 2007	EC	19	Visual search task	Famous	Frontal view	NK	SF = FFa
17	Li, 2011	WC	34	Self-other discrimination	Familiar (friend)	Profile/frontal view	Hand: Both hands Visual Presentation: Left or Right	SF = FF
18	Li, 2011	WC	34	Self-other discrimination	Familiar (friend)	Profile/frontal view	Both hands	SF < FF
19	Li, 2011	WC	44	Self-other discrimination	Familiar (friend)	Frontal view	Both hands	SF < FF
20	Liew et al., 2011	WC[a]	20	Head orientation	Familiar (faculty member and advisor's face)	Profile/frontal view	Alternatively right or left [b]	SF < FF (both faculty member and advisor's face)
21	Ma & Han, 2009	EC	20	Head orientation	Familiar (faculty member and advisor's face)	Profile/frontal view	Alternatively right or left	SF < FF (faculty member) / SF > FF (advisors' face)
22	Ma & Han, 2012a	EC	20	Self-other discrimination	Familiar (friend)	Frontal view	Right Only	SF = FF
23	Ma & Han, 2012b	EC	20	Self-other discrimination	Familiar (friend)	Profile/frontal view	Alternatively right or left	Atheists: Left hand: SF < FF / Right hand: SF =FF
24	Ma & Han, 2012a	EC	20	Self-other discrimination	Familiar (friend)	Frontal view	Alternatively right or left	Christians: Left hand: SF =FF / Right hand: SF =FF
25	Malaspina, Albonico, & Daini, 2015	EC	21	Face matching task	Unknown	Frontal View	Right hand only	SF < UF
26a	Martini et al., 2015	WC	20	Face recognition	Familiar (friends)	Frontal view	Right hand only	SF < FF
26b	Martini et al., 2015	WC	10	Face recognition	Familiar (twin and friend)	Frontal view	Right hand only	SF = FF (Twin) SF < FF (Friend)
27	Mengya, Hongxiao, Hong, & Jia, 2013 & Hongxiao, Mengya, & Hong, 2013	EC	16	Face recognition	Famous and unknown	Frontal view	Alternatively right or left	SF < FFa < UF
28	Miyakoshi, Kanayama, Nomura, Iidaka, & Ohira, 2008	EC	16	Face recognition	Famous and unknown	Profile/frontal view	Right Only	SF < FF/UF
29		EC	24	Face recognition	Famous and unknown	Frontal view	Both hands	SF < FF/UF

Table 2 (continued)

	Study	Culture	*N*	Task	Identity	Face view	Laterality	Results
	Miyakoshi, Kanayama, Iidaka, & Ohira, 2010							
30	Oikawa et al., 2012	EC	20	Familiarity judgment	Familiar and unknown	Profile/frontal view	Right Only	SF = FF / SF < UF
31	Platek & Kemp, 2009	WC	12	Face recognition	Familiar and unknown	Frontal view	NK	SF < UF / SF = FF
32	Sugiura et al., 2006	EC	42	Familiarity judgment	Familiar and unknown	Profile/frontal view	Right Only	SF = FF
33	Sugiura et al., 2008	EC	35	Familiarity judgment	Familiar and unknown	Frontal view	Right Only	SF < FF/UF
34	Sugiura et al., 2012	EC	36	Familiarity judgment	Familiar and unknown	Profile/frontal view	Right Only	SF = FF = UF
35a	Sui et al., 2009	EC	16	Head orientation	Familiar (friend)	Profile/frontal view	Both hands	Chinese: SF < FF
35b	Sui et al., 2009	WC	16	Head orientation	Familiar (friend)	Profile/frontal view	Both hands	American: SF < FF
36	Sui, Hong, Hong Liu, Humphreys, & Han, 2013	EC	18	Self-other discrimination	Familiar and unknown	Profile/frontal view	Both hands	SF < FF/UF
37	Sui, Zhu, & Han, 2006	EC	18	Head orientation	Familiar (friend) and unknown	Profile/frontal view	Both hands	SF < FF = UF
38a	Sui et al., 2013	EC	20	Head orientation	Familiar (Friend)	Profile/Frontal View	Both hands	SF < FF
38b	Sui et al., 2013	WC	20	Head orientation	Familiar (Friend)	Profile/Frontal View	Both hands	SF < FF
39	Tacikowski et al., 2010	WC	30	Familiarity judgment	Famous and unknown	Profile/frontal view	Right Only	SF < FF/UF
40	Tacikowski, Jednorog, Marchewka, & Nowicka, 2011	WC	30	Familiarity judgment	Famous and unknown	Frontal view	Right Only	SF < FF/UF
41	Tanaka, Curran, Porterfield, & Collins, 2006	WC	24	Delayed Response paradigm	Unknown	Frontal View	NK	SF = UF
42a	Tong et al., 1999	WC	8	Face detection task	Unknown	Profile/Frontal View	Both hands	SF < UF
42b	Tong et al., 1999	WC	16	Face detection task	Unknown	Profile/Frontal View	Both hands	SF < UF
43	Troje & Kersten, 1999	WC	26	Identity recognition	Familiar (colleagues)	Profile/frontal view	NK	SF < FF
44	Verosky & Todorov, 2010	WC	30	Self-other discrimination	Unknown	Frontal view	Right Only	SF < UF
45a	Wang, Kitayama, & Han, 2011	EC	14	Familiar recognition	Familiar (parents)	Frontal view	Left/Right Hand [b]	Women: SF = FF
45b	Wang, Kitayama, & Han, 2011	EC	14					Men: FF < SF
46a	Wang, Zhang, & Sui, 2011	EC	32	Head orientation	Familiar (friend)	Profile/frontal view	NK	SF < UF
46b	Wang, Zhang, & Sui, 2011	EC	28	Head orientation	Familiar (friend)	Profile/frontal view	NK	SF < UF
47	Wang & Zheng, 2015	EC	59	Explicit and Implicit face recognition task	Familiar (Lover)	Frontal View	Both hands	SF < FF (low intimacy group) SF = FF (high intimacy group)
48	Ying, Jianli, & Jian, 2004	EC	13	Morphing video	Familiar (friend) and famous	Frontal view	Alternatively right or left	SF = FF
49	Yoon et al., 2005	EC	17	Self-other discrimination	Familiar and unknown	Frontal view	Right Only	SF = FF = UF
50	Yun et al., 2014	EC	8	Self-other discrimination	Famous	Frontal view	NK	SF = FFa

WC = Western culture; EC = Eastern culture

Explicit Tasks: self–other discrimination; face recognition; visual search; face detection

Implicit tasks: Morphing video; familiarity judgment; head orientation; matching face

SF = self-face; FF = familiar face; FFa = famous face; UF = unfamiliar/unknown face

[a] Data from the Chinese sample were reported by Ma and Han (2009)

[b] Data from the two hands separately was not extracted due to lack of data

own face and to other people's faces (g_{av} = −0.185, SE = 0.217, t = −0.851, p = .396). On the other hand, when requested to perform an identification task based on memory (e.g., identifying whether the face belonged to oneself or to someone else; g_{av} = −0.339, SE = 0.081, t = −4.190, p < .001), participants were faster when responding to their own face compared with other people's faces. Likewise, when participants performed an identification task of other features of the image rather than identity (e.g., head orientation toward left or right; g_{av} = −0.495, SE = 0.172, t = −2.873, p < .005), participants were faster when responding to their own face than to other people's faces. Nevertheless, no significance was observed regarding the overall moderator effect, F(2, 113) = 0.658, p = .520.

Type of task: Attentional, memory, or perception

The effect size of each type of task indicated that when performing a task involving attentional processes (e.g., visual search task), participants responded equally quickly to their own face and to other people's faces (g_{av} = −0.185, SE = 0.217, t = −0.851, p = .396). On the other hand, when requested to perform an identification task based on memory (e.g., identifying whether the face belonged to oneself or to someone else; g_{av} = −0.339, SE = 0.081, t = −4.190, p < .001), participants were faster when responding to their own face than to other people's faces. Likewise, when participants performed an identification task of other features of the image rather than identity (e.g., head orientation toward left or right; g_{av} = −0.495, SE = 0.172, t = −2.873, p < .005), participants were faster when responding to their own face than to other people's faces. Nevertheless, no significance was observed regarding the overall moderator effect, F(2, 113) = 0.658, p = .520.

Laterality

Overall analysis indicated that the effect of the moderator *laterality* was not significant, F(2, 80) = 0.210, p = .811). Differences were observed between self–other processing in terms of reaction time regardless of whether participants used their left hand (g_{av} = −0.478, SE = 0.174, t = −2.737, p = .008), right hand (g_{av} = −0.391, SE = 0.117, t = −3.344, p = .001), or both hands (g_{av} = −0.474, SE = 0.156, t = −3.043, p = .003).

Culture

Finally, a significant effect was observed regarding the moderator *culture,* F(1, 113) = 10.900, p = .001. Participants from Western cultures responded faster to their own face than to other people's faces (g_{av} = −0.566, SE = 0.097, t = −5.820, p < .001), while for participants from Eastern cultures, the effect was not significant (g_{av} = −0.124, SE = 0.097, t = −1.275, p = .205).

Discussion

Self-face advantage has been massively investigated in the domain of cognitive psychology, neuropsychology, and social neurosciences. While attention has been devoted to further determine which cerebral regions are specifically involved in self-face processing, less effort has been made in summarizing and understanding in depth whether individuals also behaviorally respond in a specific way when seeing their own face. Thus, the main aim of this meta-analysis was to evaluate whether there is self-advantage when responding to one's own face. The overall effect of the present meta-analysis indicated that self-face processing benefits from a self-advantage, inducing a small effect size. Thus, this meta-analysis is the first to indicate that individuals respond faster to their own face in contrast to other faces. However, this initial result must be considered with caution, especially due to a high level of heterogeneity detected and publication bias.

We also considered different moderators. Below, we discuss each one of these moderators individually. The three first moderators considered in the present meta-analysis were Familiarity, Identity of the face, and Head angle. First, we considered the level of familiarity, since previous studies have shown that we respond faster to familiar faces compared with unfamiliar faces (Burton et al., 2011), and thus we could expect that the overall effect observed could be larger when considering self-face versus unfamiliar faces. Second, we considered the effect of identity, since differences have been found in terms of behavioral performance (Liccione et al., 2014), as well as physiological (Guerra, Sanchez-Adam, Anllo-Vento, Ramirez, & Vila, 2012a; Guerra et al., 2012b; Vico, Guerra, Robles, Vila, & Anllo-Vento, 2010), and neuronal (Gobbini & Haxby, 2007; Gobbini et al., 2004) processes involved in the processing of famous (people we have seen only through the media) and familiar (people we have personally encountered in life) faces. These differences may be explained by the amount and type of experience individuals have with the familiar and famous (Burton et al., 2011) as well as other affective aspects (Guerra et al., 2012a). As suggested by Liccione et al. (2014), "affective and emotional aspects related to personal narratives with others seem to play a special role in face processing" (page 8). Thus, we may expect that the self-face may rely on different processes when compared to a famous face (and unknown faces) but may be characterized by a robust mental representation such as other familiar faces, since the self-face is a familiar face as well. Thirdly, Head angle was also considered as a possible moderator since familiar faces and, notably self-faces, benefit from a view-invariant characteristic due to the amount of experience individuals have with these faces (Johnston & Edmonds, 2009). Overall, our results showed that the effect of all three moderators (Familiarity, Identity or Head angle) were not statistically significant.

Thus, our results indicated that regardless of the face identity or level of familiarity, we tend to respond faster to our own face than to other people's faces. When considering the role of identity levels, we can observe that the effect size associated with the self and other comparison increased from famous (g_{av} = - 0. 304) and personally familiar faces (g_{av} = - 0. 312) to unknown faces (g_{av} = -0.409). In other words, there may be a progression in terms of response time across these different levels of familiarity. These results also suggested that self-face processing is faster than other face processing regardless of the head angle of the face presented, in accordance with the study by Tong and Nakayama (1999) as well as Troje and Kersten (1999), who provided evidence that the self-face includes some view-invariant representations. Our results suggest that these view-invariant representations seem to be even more important when considering one's own face compared to other familiar faces.

Overall, these results indicated that the self-face may benefit from a stronger and more robust mental representation, which includes both a frontal and profile view and may result in a self-face advantage in terms of reaction time. We suggest that our results can be further discussed in light of different theories emphasizing the role of familiarity as well as the role of multisensory information in self-face recognition (see next section for a detailed discussion) obtained through photographs, the experience of seeing oneself in the mirror and by touching one's own face.

The fourth factor included in our moderator analyses was the **Type of task** employed, more specifically, whether the task to be performed relied more on memory, perception or attention. We found a self-face advantage for memory-based identification tasks. Therefore, our results are in line with previous research showing that familiar faces benefit from a robust mental representation, which results in a faster reaction time when participants are requested to identify or recognize the face (Jenkins & Burton, 2011; Johnston & Edmonds, 2009) and suggests that the self-face may benefit from an even more robust mental representation compared to other familiar faces. The same faster reaction time was observed for the tasks relying on perception-based identification. It should be noted that most studies included in this category overlap with the studies included in the “profile/frontal view” category discussed before.

Conversely, our results suggest no self-face advantage in terms of reaction time when participants were performing a visual search task or a face detection task. In agreement, Devue et al. (2009), found that the self-face does not attract attention more than others' faces, but instead participants may have difficulties in disengaging attention from their own face. This effect does not seem to be specific to self-face, but it is also present in other familiar faces. Indeed, 8 out of 12 effect sizes included under the factor “Attentional tasks” included familiar (personally familiar or famous) faces. Since the self-face as a distractor tends to interfere with the ongoing task, which would increase the difference in terms of reaction time between the self-face and other people's faces, we included in the present meta-analysis only those studies that used unknown faces as a distractor and self or familiar faces as a target. Thus, our results cannot be explained by the interference effect of self-face. It seems that when the task to be performed relies mostly on attention, all faces are detected at a similar speed. Conversely, it is also possible that the analysis was underpowered due to the small number of studies. It is also important to have in mind that the moderator type of task was not significant.

Regarding the effect of **Laterality**, our results revealed that the effect of this moderator was not statistically significant. This result can be interpreted in the light of previous evidence showing a right hemisphere specialization for processing faces in general and, more precisely, for the recognition of familiar faces (Hole & Bourne, 2010), when the task was devoid of explicit verbal requirements (Ramon & Rossion, 2012). It is suggested that the right hemisphere is involved in the storage of semantic person information based on sensory information, while the left hemisphere stores verbally coded information (Gainotti, 2015). Moreover, two meta-analyses performed by Devue and Bredart (2011) and Platek et al. (2008) seem to indicate no specific cerebral region nor a hemispheric dominance for self-face processing. Another study also suggested that there is no evidence showing that one's own face is associated with specific processes at neuronal level (Gillihan & Farah, 2005).

Finally, we also considered the effect of **Culture** on reaction time to self-face compared to other people's faces. Our results revealed that the self-face advantage was stronger for participants recruited in western countries compared to eastern countries. This result is in agreement with previous studies by Sui et al. (2009) and Liew et al. (2011) who demonstrated a larger and more consistent self-face advantage in British participants compared to Chinese participants. Results could be understood in the light of cultural differences in terms of the place of the self in society. Western countries are normally characterized by an independent self-construal while eastern cultures are mainly characterized by an interdependent self-construal (Markus & Kitayama, 1991).

Self-face advantage

Except for the significant moderator **Culture**, the other factors considered (**Familiarity**, **Identity**, **Head angle**, **Type of Task** and **Laterality**) did not moderate the overall effect of self-face advantage. In other words, our results suggest that individuals respond faster when seeing their own face regardless of these five aspects. As mentioned before, several hypotheses might help us to better understand our results.

First, our results can be interpreted in view of previous studies showing that familiar faces are processed differently from unfamiliar faces and that this effect seems to be modulated by the intensity and variability of the experience with a person (Burton et al., 2011; Jenkins & Burton, 2011). In other words, the more we have seen a face the better and more robust will be the corresponding stored representation. In light of this theory, we might suggest that individuals are in constant contact with their face through, for example, the mirror and photographs. It may enhance the stored representation of their face leading to response times in experimental studies.

Secondly, the affective response to the face might also be an important factor to consider. A series of studies conducted by Guerra, Vico, et al. (2012b) provide further support for the existence of a stronger emotional arousal associated with loved familiar faces in contrast to famous and unknown faces. Regarding the self-face, studies have shown that self-face processing is associated with stronger skin conductance compared to familiar, famous and unfamiliar faces (Bagnato et al., 2010), which may be indicative of increased emotional arousal (Guerra, Vico, et al. 2012b).

Thirdly, the self-face advantage could also be explained by implicit positive attitudes toward the self (Ma & Han, 2010). Studies have investigated whether individuals implicitly associated positive characteristics with the self. Epley and Whitchurch (2008) showed that individuals tend to have a more attractive mental representation version of their own face when compared to the real version. In short, these studies concur with social psychology studies showing that individuals tend to implicitly associate the self with positive characteristics (Koole & DeHart, 2007), which further influence response time to self-face.

Another hypothesis suggests that self-face advantage might be related to specific face processing strategies. Contrary to other individuals' faces, we mostly have contact with our own face through the mirror. The image provided by the mirror differs substantially from the direct perception of others' faces. Thus, it is suggested that different strategies are employed during self-face processing. For instance, Keyes (2012) found that self-face representation relies both on featural (processing of isolated facial features) and configural processing (processing the relationship between the different features of the face).

Fifthly, contrary to familiar, famous and unknown faces, self-face processing also relies on multisensory information including a combination of visual, somatosensory, proprioceptive, and motor information. This combination of information might lead to faster processing of self-face compared to other peoples' faces. According to Sugiura (2013), the physical self or bodily self-recognition (e.g. recognition of one's own face or body), is "grounded by the experience of bodily action accompanied by visual, somatosensory, vestibular, and interoceptive feedback", namely, sensorimotor schema (Sugiura, 2013; page 3). Thus, the ability to recognize one's own face in a static image is suggested to depend on the experience with one's face in the mirror and thus on the integration of visual, proprioceptive, motor, and tactile information. Other studies also suggest that the mental representation of one's own face may be enriched by both the visual experience we have with our own face and the combination of visual, somatosensory, proprioceptive, and motor information (Tajadura-Jimenez, Longo, Coleman, & Tsakiris, 2012; Tsakiris, 2008).

Sixthly, the self-face advantage may be explained by the "integrative self" hypothesis (Sui & Humphreys, 2015). According to Sui and Humphreys (2015), self-representations "acts as an integrative hub for information processing, helping to bind together different types of information and even different stages of processing". Consequently, self-related information will be assimilated and accumulated, creating "core self-representations", which will facilitate the processing of stimuli associated with distinct aspects of the self (e.g. physical or psychological aspects of the self), such as enhancing memory of stimuli in relation to the self (Symons & Johnson, 1997) and the integration of different self-related shapes into a single representation (Sui, He, & Humphreys, 2012).

In summary, several hypotheses might explain self-face advantage observed in the present meta-analysis. Interestingly, these arguments are not mutually exclusive, since the stored representation of one's own face might be composed of visual, proprioceptive, motor, tactile, emotional and autobiographical information, which might be what really differentiates self-face from other face processing. This stored representation of self-face might further contribute to the way individuals perceive themselves in society and in relation to others (Sugiura, 2013).

Implications for future studies on self-face processing

The results provided in the current meta-analysis contribute to the current debate on whether self-face is a unique stimulus that involves specific mechanisms. While some authors have argued and also provided evidence in favor of a self-face advantage (Keenan et al., 2001; Ma & Han, 2010), others have rather suggested that the self-face is merely a familiar face (Gillihan & Farah, 2005). Still, others have found support for specialized self-face processing brain regions, without any differences at behavioral level (Kircher et al., 2000; Kircher et al., 2001). On the one hand, by showing that the self-face indeed benefits from an advantage in terms of reaction time, our findings corroborate the hypothesis that the self-face is associated with specific processes at behavioral level that may be explained by the fact that the self-face is a unique stimulus or because we are more familiar with our own face compared to other people's faces including other familiar faces.

Although **Familiarity**, **Identity**, **Head angle**, **Type of task**, and **Laterality** do not moderate the self-face advantage, the findings of our meta-analysis should incentivize researchers to consider new aspects that might help to further understand self-face processing at behavioral level. Firstly, one should consider how factors that normally affect face recognition, such as viewpoint, expression, and context, also affect self-face processing. It is well known that recognition of familiar faces is less sensitive to these factors compared to unknown faces. Most studies included in the present meta-analysis only explored changes in head angle using standard images. To our knowledge, only one study has employed natural images during self-face processing (Bortolon et al., 2017) and found a self-face advantage over famous and unknown faces, but not over friends' faces. Secondly, another factor that should be considered is the emotional responses associated with self-face processing in contrast to other kinds of familiar faces, similar to the studies performed by Guerra and colleagues (Guerra, Sanchez-Adam, et al., 2012a; Guerra, Vico, et al., 2012b; Vico et al., 2010). Third, one should also consider the impact of the level of the bond between the individual and the familiar person. Most studies included friends' faces and did not properly access the degree of friendship or the intensity and variability of individuals' experience with this familiar person. One study by Wang and Zheng (2015), for instance, showed that the level of intimacy impacted on the processing of other people's faces by reducing the response time. Fourth, more studies should consider the cultural implications for self-processing. So far, only a few studies (Liew et al., 2011; Sui et al., 2009) have directly compared Eastern and Western cultures. Other cultures are still to be explored, notably African cultures. Previous studies have shown that African toddlers do not show the same pattern of behavior as American toddlers during the self-mirror recognition test (Broesch et al., 2010). Fifth, the performance on different tasks relying more or less on memory or attention should also be further explored. Finally, although hemispheric dominance during self-face processing has often been investigated in the past, most recent studies have neglected this aspect, which still deserves attention.

Limitations of the present study

The present meta-analysis could not include some studies due to the lack of necessary data for calculating effect size. Initially, we tried to circumvent this limitation by contacting all authors at least twice by email. Nevertheless, a large number of authors did not reply to our request. Others were unable to retrieve the data. Thus, even though we tried to include the largest possible number of studies, it is possible that other studies have not been included in this meta-analysis. Moreover, although we made great efforts to retrieve unpublished data, we were able to find only two thesis dissertations and only access the data from two studies (three experiments) of one of these theses. Moreover, authors also made a great effort to select the study characteristics for which a strong theoretical case can be made in order to avoid identifying false moderator variables (Hunter & Schimidt, 2004).

The present study presented higher levels of heterogeneity and publication bias as indicated by the Egger's test, which weakens the inferences presented here, especially considering the small effect size observed. The significant effects observed in the Egger's test can indeed be explained by a publication/reporting bias, but also by the high levels of heterogeneity observed (Sterne et al., 2011) and the fact that most data included in the present meta-analyses were extracted from studies with small samples sizes that observed positive self-face advantage effects. Although we explored the effect of six different moderators, our moderator analysis did not allow us to explain the high levels of heterogeneity described. Therefore, the results presented here should be considered with caution. Regardless of whether the bias encountered is indeed due to a publication bias and/or due to higher levels of heterogeneity, it represents an important limitation of the present meta-analysis that may limit the validity of the results.

One previous review on the subject found no evidence of self-physical uniqueness or advantage, either at the behavioral or neurocognitive level (Gillihan & Farah, 2005). Therefore, Gillihan and Farah (2005) concluded that at the time there was no consistent evidence to suggest that self-processing was a unique stimulus dissociated from nonself processing. Similarly, Devue and Bredart (2011) concluded that even though a bilateral network seems to be associated with self-face recognition, it remains difficult to dissociate specific brain areas that are associated with self-face processing, in part because of the variability of control stimuli and experimental tasks. A similar conclusion may be applied to the present results. The variability of type of stimuli and experimental task, together with the unavailability of some data, may prevent us from reaching more definite conclusions.

Moreover, our study was limited by the fact that we could not adjust for publication bias (Duval & Tweedie, 2000), since such procedures are not available for the rma.mv function of the metafor package. On the other hand, we analyzed sensitivity by defining the influential outliers and comparing the fitted model with and without these values. No influential outliers that may have affected our results were found. Moreover, one of the main strengths of this study is the use of a three-level random-effects model, since it enables us to take into account different levels of variability and dependency between effect sizes.

Conclusions

Overall, our findings suggest that the self-face benefits from advantage at behavioral level (reaction time), which might be explained by different factors such as over-familiarization with one's own face, unique experience with one's own face, multisensory integration, and attribution of positive characteristics to the self. Regarding our moderator analysis, we found that culture seems to play an important role in the way we respond to our own face in behavioral terms, probably due to the opposition between independent self-construal and interdependent self-construal that have been suggested to characterize Western and Eastern cultures, respectively.

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References

*References marked with a asterisk indicate studies included in the meta-analysis

Amsterdam, B. (1972). Mirror self-image reactions before age two. *Developmental Psychobiology, 5*(4), 297–305. https://doi.org/10.1002/dev.420050403

Assink, M., & Wibbelink, C. J. M. (2016). Fitting three-level meta-analytic models in R: A step-by-step tutorial. *The Quantitative Methods for Psychology, 12,* 154–174. https://doi.org/10.20982/tqmp.12.3.p154

Bagnato, S., Boccagni, C., Prestandrea, C., & Galardi, G. (2010). Characterisation of the sympathetic skin response evoked by own-face recognition in healthy subjects. *Functional neurology, 25*(2), 93–102.

*Bortolon, C., Capdevielle, D., Salesse, R. N., & Raffard, S. (2015). Further insight into self-face recognition in schizophrenia patients: why ambiguity matters. *Journal of Behavior Therapy and Experimental Psychiatry, 50,* 215–222.

*Bortolon, C., Lorieux, S., & Raffard, S. (2017). Self or familiar-face recognition advantage? New insight using ambient images. The Quarterly Journal of Experimental Psychology (Hove), 1–30. https://doi.org/10.1080/17470218.2017.1327982

Broesch, T. L., Callaghan, T., Henrich, J., Murphy, C., & Rochat, P. (2010). Cultural variations in children's mirror self-recognition. *Journal of Cross-Cultural Psychology* https://doi.org/10.1177/0022022110381114

Bruce, V., & Young, A. (1986). Understanding face recognition. *British Journal of Psychology, 77*(Pt. 3), 305–327.

Burton, A. M., Jenkins, R., & Schweinberger, S. R. (2011). Mental representations of familiar faces. *British Journal of Psychology, 102*(4), 943–958. https://doi.org/10.1111/j.2044-8295.2011.02039.x

*Butler, D. L., Mattingley, J. B., Cunnington, R., & Suddendorf, T. (2013). Different neural processes accompany self-recognition in photographs across the lifespan: An ERP study using dizygotic twins. *PLOS ONE, 8*(9), e72586. https://doi.org/10.1371/journal.pone.0072586

Cheung, M. W. L. (2014). Modeling dependent effect sizes with three-level meta-analyses: A structural equation modeling approach. *Psychological Methods*, *19,* 211–229. https://doi.org/10.1037/a0032968

Courage, M. L., Edisona, S. C., & Howeb, M. L. (2004). Variability in the early development of visual self-recognition. *Infant Behavior & Development*, *27*(4), 509–532. https://doi.org/10.1016/j.infbeh.2004.06.001

*Cygan, H. B., Tacikowski, P., Ostaszewski, P., Chojnicka, I., & Nowicka, A. (2014). Neural correlates of own name and own face detection in autism spectrum disorder. *PLOS ONE, 9*(1), e86020. https://doi.org/10.1371/journal.pone.0086020

Devue, C., & Bredart, S. (2008). Attention to self-referential stimuli: Can I ignore my own face? *Acta Psycholica, 128*(2), 290–297. https://doi.org/10.1016/j.actpsy.2008.02.004

Devue, C., & Bredart, S. (2011). The neural correlates of visual self-recognition. *Consciousness and Cognition*, *20*(1), 40–51. https://doi.org/10.1016/j.concog.2010.09.007

Devue, C., Van der Stigchel, S., Bredart, S., & Theeuwes, J. (2009). You do not find your own face faster; you just look at it longer. *Cognition*, *111*(1), 114–122. https://doi.org/10.1016/j.cognition.2009.01.003

Duval, S., & Tweedie, R. (2000). Trim and fill: A simple funnel-plot-based method of testing and adjusting for publication bias in meta-analysis. *Biometrics*, *56,* 455–463. https://doi.org/10.1111/j.0006-341X.2000.00455.x

Epley, N., & Whitchurch, E. (2008). Mirror, mirror on the wall: Enhancement in self-recognition. *Personality and Social Psychology Bulletin, 34*(9), 1159–1170. https://doi.org/10.1177/0146167208318601

Gainotti, G. (2015). Implications of recent findings for current cognitive models of familiar people recognition. *Neuropsychologia, 77,* 279–287. https://doi.org/10.1016/j.neuropsychologia.2015.09.002

Gallup, G. G., Jr. (1977). Self-recognition in primates: A comparative approach to the bidirectional properties of consciousness. *American Psychologist, 32*(5), 329–338.

Gillihan, S. J., & Farah, M. J. (2005). Is self special? A critical review of evidence from experimental psychology and cognitive neuroscience. *Psychological Bulletin, 131*(1), 76–97. https://doi.org/10.1037/0033-2909.131.1.76

Gobbini, M. I., & Haxby, J. V. (2007). Neural systems for recognition of familiar faces. *Neuropsychologia, 45*(1), 32–41. https://doi.org/10.1016/j.neuropsychologia.2006.04.015

Gobbini, M. I., Leibenluft, E., Santiago, N., & Haxby, J. V. (2004). Social and emotional attachment in the neural representation of faces. *NeuroImage, 22*(4), 1628–1635. https://doi.org/10.1016/j.neuroimage.2004.03.049

Guerra, P., Sanchez-Adam, A., Anllo-Vento, L., Ramirez, I., & Vila, J. (2012a). Viewing loved faces inhibits defense reactions: A health-promotion mechanism? *PLoS ONE, 7*(7), e41631. https://doi.org/10.1371/journal.pone.0041631

Guerra, P., Vico, C., Campagnoli, R., Sanchez, A., Anllo-Vento, L., & Vila, J. (2012b). Affective processing of loved familiar faces: Integrating central and peripheral electrophysiological measures. *International Journal of Psychophysiology, 85*(1), 79–87. https://doi.org/10.1016/j.ijpsycho.2011.06.004

*Heinisch, C., Wiens, S., Grundl, M., Juckel, G., & Brune, M. (2013). Self-face recognition in schizophrenia is related to insight. *European Archives of Psychiatry and Clinical Neuroscience, 263*(8), 655–662. https://doi.org/10.1007/s00406-013-0400-9

Hole, G. J., & Bourne, V. J. (2010). *Face processing: Psychological, neuropsychological and applied perspectives*. Oxford, UK: Oxford University Press.

Hong, Z. & Hongxiao, J. (2014). Self-face recognition in schizophrenia patients with positive and negative symptoms. *Journal of Capital Medical University, 35*(2), 200–204.

*Hongxiao, J., Mengya, Y., & Hong, Z. (2013). Self-face recognition of mania. *Journal of Capital Medical University, 34*(2). https://doi.org/10.3969/jissn.1006-7795.2013.02.008

Hox J (2010) Multilevel Analysis: *Techniques and Applications, Quantitative Methodology Series* (Routledge, New York), 2nd Ed.

*Hu, Y., Liao, S., Luo, W., & He, W. (2013). Effects of self-esteem on self-face recognition: An eye movement study. *Open Journal of Social Sciences, 1*(6), 40–42.

Hughes, S. M., & Nicholson, S. E. (2010). The processing of auditory and visual recognition of self-stimuli. *Consciousness and Cognition, 19*(4), 1124–1134. https://doi.org/10.1016/j.concog.2010.03.001

Hunter, J. E., & Schimidt, F. L. (2004). *Methods of meta-Analysis: Correcting error and bias in research findings* (2nd ed.). Thousand Oaks, CA: SAGE.

Irani, F. (2008). *A search for autoprosopagnosia in schizophrenia* (Doctoral dissertation). Drexel University, Philadelphia, United States of America.

Jenkins, R., & Burton, A. M. (2011). Stable face representations. *Philosophical Transactions of the Royal Society, B: Biological Sciences, 366*(1571), 1671–1683. https://doi.org/10.1098/rstb.2010.0379

Johnston, R. A., & Edmonds, A. J. (2009). Familiar and unfamiliar face recognition: A review. *Memory, 17*(5), 577–596. https://doi.org/10.1080/09658210902976969

*Keenan, J. P., Ganis, G., Freund, S., & Pascual-Leone, A. (2000). Self-face identification is increased with left hand responses. *Laterality, 5*(3), 259–268. https://doi.org/10.1080/713754382

Keenan, J. P., Freund, S., Hamilton, R. H., Ganis, G., & Pascual-Leone, A. (2000). Hand response differences in a self-face identification task. *Neuropsychologia, 38*(7), 1047–1053.

Keenan, J. P., McCutcheon, B., Freund, S., Gallup, G. G., Jr., Sanders, G., & Pascual-Leone, A. (1999). Left hand advantage in a self-face recognition task. *Neuropsychologia, 37*(12), 1421–1425.

Keenan, J. P., Nelson, A., O'Connor, M., & Pascual-Leone, A. (2001). Self-recognition and the right hemisphere. *Nature, 409*(6818), 305. https://doi.org/10.1038/35053167

Keenan, J. P., Wheeler, M. A., Gallup, G. G., Jr., & Pascual-Leone, A. (2000). Self-recognition and the right prefrontal cortex. *Trends in Cognitive Science, 4*(9), 338–344.

Keenan, J. P., Wheeler, M., Platek, S. M., Lardi, G., & Lassonde, M. (2003). Self-face processing in a callosotomy patient. *European Journal of Neuroscience, 18*(8), 2391–2395.

Keyes, H. (2012). Categorical perception effects for facial identity in robustly represented familiar and self-faces: The role of configural and featural information. *The Quarterly Journal of Experimental Psychology, 65*(4), 760–772. https://doi.org/10.1080/17470218.2011.636822

*Keyes, H., & Brady, N. (2010). Self-face recognition is characterized by "bilateral gain" and by faster, more accurate performance which persists when faces are inverted. *The Quarterly Journal of Experimental Psychology, 63*(5), 840–847. https://doi.org/10.1080/17470211003611264

*Kircher, T. T., Senior, C., Phillips, M. L., Benson, P. J., Bullmore, E. T., Brammer, M., … David, A. S. (2000). Towards a functional neuroanatomy of self processing: Effects of faces and words. *Cognitive Brain Research, 10*(1/2), 133–144.

*Kircher, T. T., Senior, C., Phillips, M. L., Rabe-Hesketh, S., Benson, P. J., Bullmore, E. T., … David, A. S. (2001). Recognizing one's own face. *Cognition, 78*(1), B1–B15.

*Kita, Y., Gunji, A., Sakihara, K., Inagaki, M., Kaga, M., Nakagawa, E., & Hosokawa, T. (2010). Scanning strategies do not modulate face identification: Eye-tracking and near-infrared spectroscopy study. *PLOS ONE, 5*(6), e11050. https://doi.org/10.1371/journal.pone.0011050

Koole, S. L., & DeHart, T. (2007). Self-affection without self-reflection: Origins, models, and consequences of implicit self-esteem. In C. Sedikide & S. Spencer (Eds.), *The self in social psychology* (pp. 36–86). New York, NY: Psychology Press.

Kotlewska, I., & Nowicka, A. (2015). Present self, past self and close-other: *Event-related potential study of face and name detection. Biological psychology, 110*, 201–211.

Lakens, D. (2013). Calculating and reporting effect sizes to facilitate cumulative science: a practical primer for t-tests and ANOVAs. *Frontiers in psychology*, 4, 863.

*Lee, J., Kwon, J. S., Shin, Y. W., Lee, K. J., & Park, S. (2007). Visual self-recognition in patients with schizophrenia. *Schizophrenia Research, 94*(1/3), 215–220. https://doi.org/10.1016/j.schres.2007.03.032

*Li, Y. H. (2011). *Self-face recognition: Perceptual distinctiveness and functional significance* (Unpublished doctoral dissertation). University Of California, Los Angeles.

Liccione, D., Moruzzi, S., Rossi, F., Manganaro, A., Porta, M., Nugrahaningsih, N., … Allegri, N. (2014). Familiarity is not notoriety: Phenomenological accounts of face recognition. *Frontiers in Human Neuroscience, 8*, 672–672.

*Liew, S. L., Ma, Y., Han, S., & Aziz-Zadeh, L. (2011). Who's afraid of the boss: Cultural differences in social hierarchies modulate self-face recognition in Chinese and Americans. *PLOS ONE, 6*(2), e16901. https://doi.org/10.1371/journal.pone.0016901

*Ma, Y., & Han, S. (2009). Self-face advantage is modulated by social threat–Boss effect on self-face recognition. *Journal of Experimental Social Psychology, 45*(4), 1048–1051. https://doi.org/10.1016/j.jesp.2009.05.008

Ma, Y., & Han, S. (2010). Why we respond faster to the self than to others? An implicit positive association theory of self-advantage during implicit face recognition. *Journal of Experimental Psychology: Human Perception and Performance, 36*(3), 619–633. https://doi.org/10.1037/a0015797

*Ma, Y., & Han, S. (2012a). Functional dissociation of the left and right fusiform gyrus in self-face recognition. *Human Brain Mapping, 33*(10), 2255–2267. https://doi.org/10.1002/hbm.21356

*Ma, Y., & Han, S. (2012b). Is the self always better than a friend? Self-face recognition in Christians and atheists. *PLOS ONE, 7*(5), e37824. https://doi.org/10.1371/journal.pone.0037824

*Malaspina, M., Albonico, A., & Daini, R. (2015). Right perceptual bias and self-face recognition in individuals with congenital prosopagnosia. *Laterality, 21*(2), 118–142. https://doi.org/10.1080/1357650X.2015.1084312

Markus, H. R., & Kitayama, S. (1991). Culture and the self: Implications for cognition, emotion, and motivation. *Psychological Review, 98*, 224–253.

*Martini, M., Bufalari, I., Stazi, M. A., & Aglioti, S. M. (2015). Is that me or my twin? Lack of self-face recognition advantage in identical twins. *PLOS ONE, 10*(4), e0120900. https://doi.org/10.1371/journal.pone.0120900

*Mengya, Y., Hongxiao, J., Hong, Z., & Jia, L. (2013). Self-face recognition of depression. *Journal of Capital Medical University, 34*(2). https://doi.org/10.3969/j.issn.1006-7795.2013.02.009

*Miyakoshi, M., Kanayama, N., Iidaka, T., & Ohira, H. (2010). EEG evidence of face-specific visual self-representation. *Neuroimage, 50*(4), 1666–1675. https://doi.org/10.1016/j.neuroimage.2010.01.030

*Miyakoshi, M., Kanayama, N., Nomura, M., Iidaka, T., & Ohira, H. (2008). ERP study of viewpoint-independence in familiar-face recognition. *International Journal of Psychophysiology, 69*(2), 119–126. https://doi.org/10.1016/j.ijpsycho.2008.03.009

Natu, V., & O'Toole, A. J. (2011). The neural processing of familiar and unfamiliar faces: A review and synopsis. *British Journal of Psychology, 102*(4), 726–747. https://doi.org/10.1111/j.2044-8295.2011.02053.x

*Oikawa, H., Sugiura, M., Sekiguchi, A., Tsukiura, T., Miyauchi, C. M., Hashimoto, T., … Kawashima, R. (2012). Self-face evaluation and self-esteem in young females: An fMRI study using contrast effect. *NeuroImage, 59*(4), 3668–3676. https://doi.org/10.1016/j.neuroimage.2011.10.098

*Platek, S. M., & Kemp, S. M. (2009). Is family special to the brain? An event-related fMRI study of familiar, familial, and self-face recognition. *Neuropsychologia, 47*(3), 849–858. https://doi.org/10.1016/j.neuropsychologia.2008.12.027

Platek, S. M., Wathne, K., Tierney, N. G., & Thomson, J. W. (2008). Neural correlates of self-face recognition: An effect-location meta-analysis. *Brain Research, 1232,* 173–184. https://doi.org/10.1016/j.brainres.2008.07.010

R Development Core Team (2005) R: *A Language and Environment for Statistical Computing* (R Foundation for Statistical Programming, Vienna).

Ramon, M., & Rossion, B. (2012). Hemisphere-dependent holistic processing of familiar faces. *Brain and Cognition, 78*(1), 7–13. https://doi.org/10.1016/j.bandc.2011.10.009

Rochat, P. (2003). Five levels of self-awareness as they unfold early in life. *Consciousness and Cognition, 12,* 717–731.

Rochat, P., Broesch, T., & Jayne, K. (2012). Social awareness and early self-recognition. *Consciousness and Cognition*, 21(3), 1491-1497. https://doi.org/10.1016/j.concog.2012.04.007

Rosenthal, R. (1991). *Meta-analytic procedures for social research* (Vol. 6). Newbury Park, CA: SAGE. https://doi.org/10.4135/9781412984997

Sterne, J. A., Sutton, A. J., Ioannidis, J. P., Terrin, N., Jones, D. R., Lau, J., ... & Tetzlaff, J. (2011). Recommendations for examining and interpreting funnel plot asymmetry in meta-analyses of randomised controlled trials. Bmj, 343, d4002.

Sugiura, M. (2013). Associative account of self-cognition: Extended forward model and multi-layer structure. *Frontiers of Human Neuroscience*, *7,* 535. https://doi.org/10.3389/fnhum.2013.00535

*Sugiura, M., Sassa, Y., Jeong, H., Horie, K., Sato, S., & Kawashima, R. (2008). Face-specific and domain-general characteristics of cortical responses during self-recognition. *NeuroImage, 42*(1), 414–422. https://doi.org/10.1016/j.neuroimage.2008.03.054

*Sugiura, M., Sassa, Y., Jeong, H., Miura, N., Akitsuki, Y., Horie, K., … Kawashima, R. (2006). Multiple brain networks for visual self-recognition with different sensitivity for motion and body part. *Neuroimage, 32*(4), 1905-1917. https://doi.org/10.1016/j.neuroimage.2006.05.026

*Sugiura, M., Sassa, Y., Jeong, H., Wakusawa, K., Horie, K., Sato, S., & Kawashima, R. (2012). Self-face recognition in social context. *Human Brain Mapping, 33*(6), 1364–1374. https://doi.org/10.1002/hbm.21290

Sugiura, M., Watanabe, J., Maeda, Y., Matsue, Y., Fukuda, H., & Kawashima, R. (2005). Cortical mechanisms of visual self-recognition. *NeuroImage*, *24*(1), 143–149. https://doi.org/10.1016/j.neuroimage.2004.07.063

Sui, J., He, X., & Humphreys, G. W. (2012). Perceptual effects of social salience: Evidence from self-prioritization effects on perceptual matching. *Journal of Experimental Psychology: Human Perception and Performance, 38*(5), 1105.

*Sui, J., Hong, Y. Y., Hong Liu, C., Humphreys, G. W., & Han, S. (2013). Dynamic cultural modulation of neural responses to one's own and friend's faces. *Social Cognitive and Affective Neuroscience, 8*(3), 326–332. https://doi.org/10.1093/scan/nss001

Sui, J., & Humphreys, G. W. (2015). The integrative self: How self-reference integrates perception and memory. *Trends in Cognitive Sciences, 19*(12), 719–728.

*Sui, J., Liu, C. H., & Han, S. (2009). Cultural difference in neural mechanisms of self-recognition. *Social Neuroscience, 4*(5), 402–411. https://doi.org/10.1080/17470910802674825

*Sui, J., Zhu, Y., & Han, S. (2006). Self-face recognition in attended and unattended conditions: An event-related brain potential study. *NeuroReport, 17*(4), 423–427. https://doi.org/10.1097/01.wnr.0000203357.65190.61

Symons, C. S., & Johnson, B. T. (1997). The self-reference effect in memory: A meta-analysis. *Psychological Bulletin, 121*(3), 371.

*Tacikowski, P., & Nowicka, A. (2010). Allocation of attention to self-name and self-face: An ERP study. *Biological Psychology, 84*(2), 318–324. https://doi.org/10.1016/j.biopsycho.2010.03.009

*Tacikowski, P., Jednorog, K., Marchewka, A., & Nowicka, A. (2011). How multiple repetitions influence the processing of self-, famous and unknown names and faces: An ERP study. *International Journal of Psychophysiology, 79*(2), 219–230. https://doi.org/10.1016/j.ijpsycho.2010.10.010

Tajadura-Jimenez, A., Grehl, S., & Tsakiris, M. (2012). The other in me: Interpersonal multisensory stimulation changes the mental representation of the self. *PLoS ONE, 7*(7), e40682. https://doi.org/10.1371/journal.pone.0040682

*Tanaka, J. W., Curran, T., Porterfield, A. L., & Collins, D. (2006). Activation of preexisting and acquired face representations: The N250 event-related potential as an index of face familiarity. *Journal of Cognitive Neuroscience, 18*(9), 1488–1497. https://doi.org/10.1162/jocn.2006.18.9.1488

*Tong, F., & Nakayama, K. (1999). Robust representations for faces: Evidence from visual search. *Journal of Experimental Psychology: Human Perception and Performance, 25*(4), 1016–1035.

*Troje, N. F., & Kersten, D. (1999). Dependent recognition of familiar faces. *Perception, 28*(4), 483–487.

Tsakiris, M. (2008). Looking for myself: Current multisensory input alters self-face recognition. *PLoS ONE, 3*(12), e4040. https://doi.org/10.1371/journal.pone.0004040

Turk, D. J., Heatherton, T. F., Kelley, W. M., Funnell, M. G., Gazzaniga, M. S., & Macrae, C. N. (2002). Mike or me? Self-recognition in a split-brain patient. *Nature Neuroscience, 5*(9), 841–842. https://doi.org/10.1038/nn907

Uddin, L. Q., Rayman, J., & Zaidel, E. (2005). Split-brain reveals separate but equal self-recognition in the two cerebral hemispheres. *Consciousness and Cognition, 14*(3), 633–640. https://doi.org/10.1016/j.concog.2005.01.008

Van den Noortgate, W., López-López, J. A., Marín-Martínez, F., & Sánchez-Meca, J. (2013). Three-level meta-analysis of dependent effect sizes. *Behavior Research Methods, 45,* 576–594. https://doi.org/10.3758/s13428-012-0261-6

*Verosky, S. C., & Todorov, A. (2010). Differential neural responses to faces physically similar to the self as a function of their valence. *NeuroImage, 49*(2), 1690–1698. https://doi.org/10.1016/j.neuroimage.2009.10.017

Vico, C., Guerra, P., Robles, H., Vila, J., & Anllo-Vento, L. (2010). Affective processing of loved faces: Contributions from peripheral and central electrophysiology. *Neuropsychologia, 48*(10), 2894–2902. https://doi.org/10.1016/j.neuropsychologia.2010.05.031

Viechtbauer, W. (2010). Conducting meta-analyses in R with the metafor package. *Journal of Statistical Software, 36,* 1–48.

*Wang, J., Kitayama, S., & Han, S. (2011). Sex difference in the processing of task-relevant and task-irrelevant social information: An event-related potential study of familiar face recognition. *Brain Research, 1408,* 41–51. https://doi.org/10.1016/j.brainres.2011.05.060

*Wang, J., & Zheng, Y. (2015). The effect of genuine intimacy between lovers on self-face advantage. *Advances in Psychology, 5*(12), 753–761.

*Wang, L.-Y., Zhang, M., & Sui, J. (2011). Self-face advantage benefits from a visual self-reference frame. *Acta Psychologica Sinica, 43*(05), 494–499.

Ying, Z., Jianli, Z., & Jian, Z. (2004). Self-face identification in Chinese students. Acta Pyshcologica Sinica,* 36(4), 442–447.

Yoon, H. W., & Kircher, T. T. (2005). The influence of face similarity in the case of the perception of morphed self-face. *International journal of neuroscience, 115*(6), 839–849.

*Yun, J. Y., Hur, J. W., Jung, W. H., Jang, J. H., Youn, T., Kang, D. H., ... Kwon, J. S. (2014). Dysfunctional role of parietal lobe during self-face recognition in schizophrenia. *Schizophrenia Research, 152*(1), 81–88. https://doi.org/10.1016/j.schres.2013.07.010