Recognizing Themselves and Their Friends: Female Children Do It Better

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Abstract

Three experiments were carried out to investigate how adults and children of different age recognize whole faces, facial features and body parts of themselves and their friends. Results were straightforward in demonstrating that, at least when presented with familiar stimuli, adults did not show any evidence of "self-effect" nor of gender difference. In turn, findings from children groups were consistent with the hypothesis that the abilities to process the different internal facial features follow different, specific, developmental courses and processing of the eyes begins and matures earlier than processing of the mouth and the nose. Furthermore, young perceivers showed a clear self-effect because of which they tended to look at their own face longer than other, familiar identities. Finally, data presented here clearly suggest a developmental advantage for female children in face processing.

Keywords

Face Processing, Facial Features, Gender Effect, Self Effect

1. Introduction

Unlike other living species whose behavior is mainly driven by olfactory or auditory cues, humans appear to rely preferentially on visual signals for their perception of the outside world.

Among the others, faces are likely to be the most influential visual stimuli an individual can be exposed to. Indeed, humans are social animals by nature and faces convey most of the relevant information necessary for social interactions and interpersonal relationships (Minnebusch & Daum, 2009). On one side, "face traits" pass on static information about ethnicity, gender, age, identity, thus allowing individual's recognition. On the other, "face states" transmit dynamic information about face owners' emotional status and intentions. Finally, follow-

ing an inescapable, even though illogical, propensity to judge a book from its cover, people tend to predict character and psychological traits from facial features (Willis & Todorov, 2006). Considering that all this amount of information can be captured at a glance, one must get to the conclusion that humans—with the sole exception of prosopoagnosic subjects—are very expert at face processing.

There is now wide consensus that this ability depends on a cognitive module specialized for face perception, located in the fusiform gyrus (Kanwisher, McDermott, & Chun, 1997). Albeit immature, the cognitive module subserving face processing is already functioning at birth and newborn infants aged few days prefer to look at faces (Morton & Johnson, 1991) and face-like stimuli (Goren, Sarty, & Wu, 1975; Valenza, Simion, Cassia, & Umiltà, 1996) more than at any other visual object. Provided appropriate environmental inputs, the innate predisposition for facial stimuli gradually evolves during infancy and childhood to be completed by puberty (see Macchi Cassia, 2011, for a review). Classically, it has been taught that young (i.e. under age 10 - 12) children perceive faces in a different way than older (i.e. over age 10 - 12) children and adults. That is, while mature perceivers encode faces in a way that integrates features together (holistic effect), developing perceivers use a piecemeal or analytic strategy reliant on distinctive facial features (Schwarzer, 2000). Consistently, the "face inversion effect" according to which upside down faces are much harder to recognize, has been usually found in adult, but not very young perceivers (Carey & Diamond, 1977). This assumption, however, has been challenged by the demonstration of the face inversion effect among children as well adults. For instance, a recent study mainly aimed to assess the "other-age" effect, demonstrated a face inversion effect, and thus a holistic perception, already in 3-y-o children (Proietti, Pisacane, & Macchi Cassia, 2013). The empirical evidence, however, is still inconclusive. While some studies support the notion that adult-like holistic perception slowly matures throughout late childhood and adolescence (Carey, Diamond, & Woods, 1980), but is not fully developed even among 14-year-olds (Mondloch, Dobson, Parsons, & Maurer, 2004; Mondloch, Geldart, Maurer, & Le Grand, 2003), other studies are consistent with the hypothesis that facial processing abilities mature between 4 and 7 years of age and their neural bases do not change from late childhood to adulthood (Crookes & McKone, 2009; De Heering, Houthuys, & Rossion, 2007).

However, as Ge et al. (2008) correctly pointed out, "The focus on when configural processing emerges, as well as the ongoing theoretical debate regarding the encoding switch hypothesis has eclipsed the research on how children process featural information". Several studies addressed the issue of featural processing in children. Once again, findings are inconsistent. Most of the studies focused on the shift between outer- to inner-face advantage. Campbell et al. (1999) found that, when requested to recognize celebrities' faces, 5- to 13-y-o participants rely more on external facial features (i.e., "outer-face advantage") while the opposite

was true (i.e. "inner-face advantage") for 14-y-o and 15-y-o participants who demonstrated an adult-like preference for internal facial features, thus confirming their relevance in learning unknown faces (Longmore, Liu, & Young, 2015). Analogously, an outer-face advantage in the recognition of unfamiliar adult faces was reported in 5- to 9-y-o children (Want, Pascalis, Coleman, & Blades, 2003), likely because young perceivers find difficult to disregard information from external features of unfamiliar faces (Sugimura, 2013). However, when requested to recognize familiar adult faces, 5-y-o children turned out to rely more on internal than on external face parts (Wilson, Blades, & Pascalis, 2007). Things do not become clearer when children's instead of adults' faces are used. While Campbell, Walker, & Baron-Cohen (1995) reported an outer-face advantage for 7-year-olds, but an inner-face advantage for 9-year-olds engaged in the recognition of familiar schoolmates, Bonner & Burton (2004), found an inner-face advantage in 7-y-o children on a matching task with faces of familiar schoolmates. Inconsistency across studies may be explained by arguing that perceivers rely more on inner or outer features depending on the level of familiarity: the more familiar the face the higher the inner-face advantage (Campbell et al., 1999; Clutterbuck & Johnston, 2004; Ellis, Shepherd, & Davies, 1979; Young, Hay, McWeeny, Flude, & Ellis, 1985). In this vein, the own-age and own-race effects according to which own-age and own-race faces are better recognized than other-age (Kuefner, Macchi Cassia, Picozzi, & Bricolo, 2008), and other-race (Kelly et al., 2007) faces, respectively, further support the idea that natural experience with faces (Proietti et al., 2013) modulates the development of face recognition abilities during childhood.

Strictly linked with the effect of familiarity, is the so-called "self effect" according to which one's own face grabs more attention than other identities (Brédart, Delchambre, & Laureys, 2006). Indeed, apart from monozygotic twins who equally recognize their own face and their twin's face (Martini, Bufalari, Stazi, & Agliotti, 2015), ordinary people show a self-face advantage so strong to persist even when very familiar faces are used or faces are inverted (Keyes & Brady, 2010). Evidence from brain damaged children demonstrated that self recognition is present from 4 years of age, although the difference self/other is more evident for body than face parts (Frassinetti et al., 2012).

That leads to the issue of how children process the different internal facial features. As usual, empirical evidence is far from being uncontroversial. While there is a wide consensus as to the fact that eyes are the most relevant facial feature for adult perceivers, thus playing a critical role in "what makes faces so special" (Itier, Alain, Sedore, & McIntosh, 2007), developmental data are still uncertain. Some studies demonstrated a slow development of the ability to process the shape of internal facial features, so that—for instance—8-y-o children are less sensitive than adults to the spacing of internal features (Mondloch et al., 2004). Furthermore, the abilities to process the different internal facial features seem to follow different, specific developmental courses with processing of the

mouth developed before processing of the eyes as suggested by the fact that mouth turned out to be relatively more influential than the eyes in 5-y-olds' identity judgments of adult faces (Schwarzer & Massaro, 2001). On the other side, however, there are studies that support the notion that the neural bases of face processing are present from 4 years of age and do not change throughout development (Kuefner, de Heering, Jacques, Palmero-Soler, & Rossion, 2009). Accordingly, even youngest children show an electrophysiological pattern of face sensitivity similar to that seen in adults (Taylor, Edmonds, McCarthy, & Allison, 2001), although an adult-like pattern of the N170 is reached only by mid-teens (Taylor, Batty, & Itier, 2004). The early presence of an eye detector accounts for the fact that, when requested to process familiar own-age faces, young children are better at recognizing the eyes than the mouth and nose regions (Hay & Cox, 2000; Pellicano, Rhodes, & Peters, 2006).

Finally, a last point deserves to be considered. Some studies with adult participants reported a women's higher performance in the recognition of faces, although it is not entirely clear whether this advantage depends on a superiority in recognizing only female faces (Lewin & Herlitz, 2002) or faces in general (McBain, Norton, & Chen, 2009). Other studies, however, provided behavioral and electrophysiological evidence of a stable male advantage in self-resembling child faces processing (Wu, Yang, Sun, Liu, & Luo, 2013). As to children, it is now clear that infants prefer female rather than male faces (Hillairet de Boisferon, Uttley, Quinn, Lee, & Pascalis, 2014), but empirical evidence is still lacking as to a gender superiority in face processing during childhood.

The present study aims to re-assess adults' and children's ability to recognize their own and their friends' faces as well as body and face parts. In particular, the experimental tests allowed to investigate: 1) whether the ability to recognize whole faces as well as body (i.e. hands) and face parts is differentially developed in adults and children of different ages; 2) whether this ability is differentially developed in females and males of different age groups; 3) whether the performance of adults and children differs depending on the type of task, namely, whether recognizing "self" items is easier and faster than recognizing stimuli belonging to other people, either of the same or the different gender.

2. Method

The study was approved by the Schools' Ethical Committee and carried out in accordance with the Declaration of Helsinki guidelines. The adult participants gave their informed consent. The children's parents gave informed consent and the youngsters gave assent. All of the participants had normal or corrected-to-normal visual acuity, did not suffer or have suffered from neurological or psychiatric problems, and were unaware of the purpose of the study.

2.1. Participants

Sixteen (8 females) young adults, thirty-two (16 females) 5-year-old, and sixteen

(8 females) 8-year-old pupils, volunteered to participate into research, and were involved into different experiments according to the details listed below.

The adults were eight married or engaged couples, linked by a strong, long lasting, friendship relationship so that all of them were very familiar to each other. In turn, both 5- and 8-year-old pupils were attending the third grade of kindergarten or primary school, respectively. Given that all the pupils had been in the same classroom for more than two years, all of them were very familiar with their classmates. In each subgroup of age, the participants were further divided into subgroups of eight (4 females) so that each participant was inserted in a group with three friends of the same gender and four friends of the opposite gender.

2.2. Stimuli

The experimental stimuli were black-and-white photographs taken with a digital SLR camera at a distance of about 40 cm against a white background. For optimal recognition, the subjects were required to have a frontal orientation with the most neutral expression possible during face photographs, and to keep their hands open, palms down with fingers completely extended during hand photographs. In a further step, a commercial software program (Photoshop, Adobe Systems) was used to trim the face images in a standard oval removing salient cues (e.g. ears, hair) as well as specific features (i.e. eyes, nose, mouth) and keep stimuli size and brightness uniform. Each photograph belonged to one of four categories of stimuli: Whole Faces, Features in Isolation, Faces Without One Feature, Faces With Only One Feature. The Features in Isolation category included 5 subtypes of stimuli: eyes, nose, mouth, left hand, and right hand. In turn, the last two categories included 3 subtypes of stimuli each: faces without the eyes, the mouth, the nose, and faces with only the eyes, only the mouth, only the nose, respectively (see Figure 1). Thus, to sum up, there were 12 types of stimuli to be used in various experiments. For brief, they were labeled as Faces, Eyes, Nose, Mouth, LH, RH, noEyes, noNose, noMouth, onlyEyes, onlyNose, onlyMouth, respectively.

2.3. Apparatus and Procedure

A commercial software program (E-Prime, Psychology Software Tools, Inc.), was used to implement the experimental paradigm. All the experimental sessions were conducted in a sound- and light-attenuated room using an IBM compatible notebook. Stimuli were displayed on the 14-inch notebook monitor. Participants were comfortably seated in front of the computer monitor so that the distance between the eyes and the center of the monitor was approximately 60 cm. An acoustic warning signal from an acoustic box incorporated in the notebook prompted the subject to start the trial. A response box with four diamond-shaped buttons (i.e. top, down, left, right), connected to the notebook via a parallel port was used to record participants' responses.

(a) noEyes　　　　(b) noMouth　　　　(c) noNose

(d) onlyEyes　　　　(e) onlyMouth　　　　(f) onlyNose
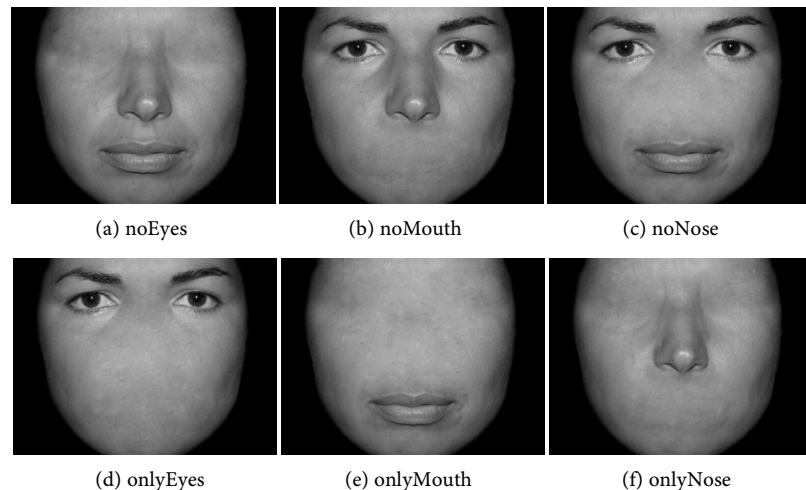
Figure 1. Examples of stimuli used in Experiment 3 face features.

The experimental investigation assessed participants' performance on three tasks: Self, Same Gender (SG), Opposite Gender (OG). In all these tasks each participant was presented only with stimuli derived from his/her own subgroup. In the Self task, the participants had to recognize the pictures of themselves; in the SG and OG tasks they were to recognize the pictures of their best friend of the same or the opposite gender (his/her partner for the adults), respectively. It is relevant to note that the stimuli used in the Self task were the same as those used in the SG task, the only difference being the targets the participants had to identify: stimuli of themselves in the first case, of their same gender best friend in the latter.

Self, SG, and OG tasks were run in this fixed order by all the participants. Before starting each experiment, a few practice trials were administered to ensure that the participant had understood the procedure.

In each trial in each task, stimuli were presented four at a time according to a diamond-shaped arrangement. Thus, in each trial a target and three distractors were displayed. The three distractors were always three stimuli of the same type and gender as the target. The position of the target and distractors were counterbalanced across trials so that in each session the target was presented an equal number of times in the top, right, down and left position. Participants were requested to express their choice by pressing the button corresponding to the position of the supposed target (i.e. left button for indicating the stimulus on the left, right button for the stimulus on the right, and so on). Stimuli were shown until the participant made his/her choice, but not longer than 4 sec.

For each type of stimuli, two dependent variables were recorded: Accuracy, measured in terms of number of errors, and Speed of Response, measured in terms of median reaction time (RT), provided that latencies longer than 4500 ms and shorter than 250 ms were considered to be outliers and discarded. In each experiment, however, analysis on RT was run only when the level of accuracy was so high (ceiling effect) to prevent any quantitative analysis. Accuracy and

RT data were entered in two repeated measures ANOVA and Bonferroni correction for multiple comparisons was applied. Finally, a p-value of <.05 was considered to indicate statistical significance.

As said above, each participant was presented only with stimuli from the 8 individuals of his/her own subgroup. Given that separate analyses on the different subgroups of the same age gave always comparable results, these were put together, and statistical analyses were run on the whole sample of participants of the same age group.

3. Experiment 1—Whole Faces

Sixteen (8 females) young adults, thirty-two (16 females) 5-year-old, and sixteen (8 females) 8-year-old pupils were involved in this experiment.

In each of the three experimental sessions (Self, SG, and OG) there were 32 trials, so the target was presented eight times in each of the four spatial positions. Only young adults ran additional sessions in which the same stimuli were presented upside-down rather than upright.

3.1. Results and Discussion

Hereafter (Table 1), the detailed results from the three groups of participants (16 participants for each group).

3.1.1. Adults

In all testing conditions, participants were extremely accurate. However, although the number of errors they made was too small to be entered into any quantitative analysis, some qualitative observations on their pattern of performance are still possible. First, the number of errors was absolutely negligible with upright stimuli (overall error rate < 1%), but markedly increased with upside-down stimuli (overall error rate = 7.3%). Second, the number of errors only marginally increased from Self to SG and OG task; namely, the participants' performance did not vary substantially across the different sessions. Third, no significant difference emerged between males' and females' performance.

With regard to the Speed of Response, RT data were entered in a repeated measures ANOVA with Gender (Females vs. Males) as the between-subjects factor, while Task (Self vs. SG vs. OG) and Stimulus Orientation (Upright vs. Upside Down) were the within-subjects factors. The main results were that the factor Gender was far from significance and the three tasks were absolutely indistinguishable from each other. On the opposite, the factor Stimulus Orientation was highly significant [F (1, 14) = 116.1, p < .001] because, as expected, across the tasks, responses to upright (mean RT = 1269 ms.) were consistently much faster than responses to upside-down (mean RT = 1792 ms.) stimuli.

3.1.2. Eight-Years-Old Children

8-y-o children turned out to be as accurate, although slower, than adults. This at ceiling performance prevented to run any quantitative analysis on accuracy data.

Table 1. Whole Faces: accuracy (% of errors) and speed of response (mean RT in ms.).

Task Stimuli		Adults Upright		Adults Upside Down		8-y-o Children Upright		5-y-o Children Upright	
		Acc	RT	Acc	RT	Acc	RT	Acc	RT
Self	females	0	1339	0	1750	0	2173	1.2	2664
	males	0	1247	9.4	1730	0	2313	4.3	2819
SG	females	0	1201	0	1539	0	1900	1.2	2293
	males	1.6	1222	12.5	2167	.8	2201	5.5	2623
OG	females	3.1	1278	12.5	2005	0	2026	2.7	2197
	males	0	1326	9.4	1563	.8	2027	.8	2745
mean		.8	1269	7.3	1792	.3	2107	2.6	2557

In turn, analysis based on RT (ANOVA with Gender as the between-subjects factor, and Task as the within-subjects factor) showed that 8-y-o children pupils were faster in responding to both SG and OG than Self stimuli (p = .026 and .028, respectively), so the factor Task reached significance [F (2, 28) = 6.470, p = .005]. The factor Gender was significant as well [F (1, 14) = 5.303, p = .037] because females (mean RT = 2033 ms.) responded faster than males (mean RT = 2180 ms.) in both Self and SG tasks, while no gender difference was observed in the OG task.

3.1.3. Five-Years-Old Children

Also 5-y-o children were very accurate, thus making any quantitative analysis meaningless. However, it is worthy to note that while all the females made very few, if any, errors, two males failed to recognize more than 50% of stimuli across the different tasks.

In addition, several participants found difficult to use the response box, so gave their responses by pointing to the target and the examiner entered the choice on the computer. Because of this, only RT data from sixteen children (8 females) were entered in a repeated measures ANOVA with Gender as the between-subjects factor, and Task as the within-subjects factor. As their older mates, 5-y-o children were faster in responding to both SG and OG than Self stimuli, so that the factor Task showed a clear tendency toward significance [F (2, 28) = 3.176, p = .057]. In turn, the factor Gender was significant [F (1, 14) = 5.303, p = .037] because females (mean RT = 2385 ms.) responded faster than males (mean RT = 2729 ms.) in all the tasks, thus making the interaction Gender by Task not significant.

To sum up, only a robust effect of stimulus orientation emerged among adult participants. Not surprisingly, upright stimuli were recognized faster and better than upside-down stimuli (see Valentine, 1988, for a review of the effects of inversion upon face recognition). Furthermore, likely because the task was only

relatively challenging, with both upright and inverted faces, we failed to observe any evidence of self-face advantage (Keyes & Brady, 2010) nor did we observe any evidence of the female advantage in face recognition previously reported by other investigators (Cellerino, Borghetti, & Sartucci, 2004; McBain, Norton, & Chen, 2009; Sun, Gao, & Han, 2010).

Things were much more intriguing when children's performance was considered. Both the two groups of children have shown to have a strong task effect, being faster in responding to SG and OG than Self stimuli. At least two hypotheses, not mutually exclusive, can be put forward to explain these apparently paradoxical findings. First, faster responses in SG and OG tasks may simply reflect a practice effect on tasks carried out later (but it should be explained why this effect was only observed between the first and the second, but not between the second and the third task). The second, and more probable, explanation holds that the longer time taken to respond to self-faces may depend on a deeper emotional involvement at work in this session. As demonstrated by Devue, Van der Stigchel, Brédart, & Theeuwes (2009), when presented with their own face, perceivers tend to look at it longer, rather than to find it faster. Namely, the self-face advantage mainly consists in a difficulty to disengage attention from the self-face rather than in a differential, privileged, processing of it.

Furthermore, unlike adults, younger participants showed a clear gender difference with females of both age groups more accurate and faster than their male peers. Although in need of further substantiation, this result suggests a developmental advantage for female children in face processing. In this vein, it is also relevant to note that while 5-y-o females performed better than their male peers in all the three tasks, among 8-y-o children the female superiority was observed with both Self and SG, but not OG stimuli. That seems to suggest that, like adults (Lewin & Herlitz, 2002), older female children are better than male peers in recognizing female, but not male faces.

After experiment 1, the different age groups were divided into two subgroups: one was to participate into experiment 2, the other into experiment 3.

4. Experiment 2—Face and Body Features

Eight (4 females) 5-y-o children weren't available so the experiment was carried out on three groups of 8 (4 females) participants each: adults, 8-y-o, and 5-y-o children.

The procedure was absolutely consistent with that adopted in experiment 1. The only difference was that this time experimental stimuli represented five types of face and body parts (i.e. eyes, nose, mouth, LH and RH) in isolation for a total of 40 trials per session.

4.1. Results and Discussion

Table 2 shows the detailed results from the three groups of participants (8 participants for each group).

Table 2. Features in isolation.

	1) Adults (RT in ms.)					
Task		Eyes	Nose	Mouth	Left Hand	Right Hand
Self		1460	2295	2226	2263	2453
SG		1721	2446	3107	2526	2773
OG		1912	2454	2566	2455	2657
mean		1698	2398	2633	2415	2628
	2) 8-y-o Children (Accuracy % of errors)					
Self	females	0	18.75	6.25	31.25	25.00
	males	0	81.25	12.50	62.50	56.25
SG	females	0	12.50	0	6.25	12.50
	males	0	68.75	18.75	81.25	68.75
OG	females	0	37.50	6.25	56.25	56.25
	males	0	37.50	37.50	50	43.75
mean		0	42.7	13.5	47.9	43.8
	3) 5-y-o Children (Accuracy % of errors)					
Self	females	0	56.25	18.75	18.75	81.25
	males	25.00	31.25	87.50	50.00	62.50
SG	females	12.5	75.0	37.5	75.0	68.8
	males	0	56.25	87.50	100.0	93.8
OG	females	12.5	56.25	62.5	81.25	87.50
	males	12.5	87.50	31.25	37.5	75.0
mean		10.4	60.4	54.2	60.4	78.1

4.1.1. Adults

Adults were extremely accurate in all testing conditions (i.e. overall error rate < 3%) so their performance was analyzed only in terms of speed of response. The main results were as follows: although females (mean RT = 2185 ms.) were overall a bit faster than males (mean RT = 2523 ms.), the factor Gender and its interactions were all far from significance. The same was true for the factor task and its interactions. By contrast, the factor Feature was significant [$F_{(4, 24)}$ = 4.954, p = .005], because participants were much faster in recognizing Eyes than any other feature, but it deserves to note that only the difference with LH and RH, (p = .004 and .006, respectively) was significant.

4.1.2. Eight-Years-Old Children

Compared to adults' performance, the number of errors markedly increased when the 8-y-o children's performance was considered (overall error rate =

29.6%). Females turned out to be much more accurate than males (error rate = 17.9% vs. 41.2%) so the factor Gender (but not its interactions) was highly significant [$F_{(1, 6)}$ = 38.244, $p < .001$]. The factor Task and its interactions were far from significance. By contrast, the factor Feature was highly significant [$F_{(4, 24)}$ = 11.345, $p < .001$] because 8-y-o children made no errors in recognizing the stimuli Eyes which then were significantly different from LH ($p = .028$), RH ($p = .004$) and Nose ($p = .005$), but not Mouth which, in turn, was different from LH ($p = .018$).

4.1.3. Five-Years-Old Children

The number of errors markedly increased when the 5-y-o children's performance was considered. Indeed, they made an enormous number of errors (overall error rate = 52.7%) and in many experimental conditions their performance was at chance level or even below. Notwithstanding that females (error rate = 49.6%) were a bit more accurate than males (error rate = 55.8%), the factor Gender and its interactions were not significant. Moreover, younger children were more accurate in the Self than SG and OG tasks, thus the factor Task was very near to significance [$F_{(2, 12)}$ = 3.713, $p = .056$]. Needless to say, once again, the factor Feature was highly significant [$F_{(4, 24)}$ = 34.229, $p < .001$] because 5-y-o children were much more accurate in recognizing the Eyes (error rate = 10.4%) than all the other stimuli ($p < 001$ in all cases, but Mouth: $p = .044$) which, in turn, did not differ from each other.

In summary, findings from experiment 2 are consistent with the notion that face parts are easier to recognize than body parts (Bank, Rhodes, Read, & Jeffery, 2015) and eyes are the most relevant and recognizable facial feature (Taylor et al., 2001). Indeed, our results are straightforward in demonstrating that processing of the eyes begins and matures earlier, so that, unlike what found by Schwarzer & Massaro (2001) who used adult faces as stimuli, the eyes turned out to be more influential than the mouth even in 5-y-olds' identity judgments of familiar, children faces (Hay & Cox, 2000; Pellicano et al., 2006).

The most interesting finding from experiment 2, however, has to do with the developmental course of the ability to recognize body and face parts presented in isolation. This turned out to be a very difficult task for 5-y-o, but not 8-y-o children, especially if female. That demonstrates that the ability to recognize body and face parts in isolation develops during middle childhood and matures earlier in females than males, likely because females are more involved in human relationships and so more experienced with faces (Ge et al., 2008).

With the aim to investigate to what extent the presence of a face contour could make easier to recognize the different facial features, a third experiment was carried out.

5. Experiment 3—Faces with or without Features

Like experiment 2, also this experiment was carried out on three groups of 8 (4 females) participants each: adults, 8-y-o, and 5-y-o children.

In each of the three experimental sessions (Self, SG, and OG) there were 96 trials, so that for each of the 6 types of stimuli presented (i.e. noEyes, noNose, noMouth, onlyEyes, onlyNose, onlyMouth) the stimulus target was presented four times in each of the four spatial positions. Also in this experiment, adults ran additional sessions with upside-down stimuli.

5.1. Results and Discussion

Table 3 shows the detailed results from the three groups of participants.

5.1.1. Adults

When presented with upright stimuli, all the participants were extremely accurate across the different tasks. Actually, the number of errors they made was absolutely negligible with all the types of stimuli, but one: onlyNose for which an overall error rate of 25% was recorded.

Table 3. Faces with and without features. accuracy (% of errors).

	Task	noEyes	noMouth	noNose	OnlyEyes	OnlyMouth	OnlyNose
1) Adult subjects							
Self	Upright	4.7	1.6	0	1.6	0	26.6
	Upside down	15.6	12.5	6.3	14.1	9.4	15.6
SG	Upright	0	1.6	0	4.7	1.6	15.6
	Upside down	18.8	14.1	7.8	15.6	18.8	34.4
OG	Upright	0	0	1.6	1.6	3.1	32.8
	Upside down	9.4	12.5	21.9	12.5	28.1	23.4
2) 8-y-o Children Upright stimuli							
Self	females	21.9	6.3	.0	6.3	53.1	65.2
	males	18.8	6.3	3.1	6.3	34.4	68.8
SG	females	15.6	.0	.0	3.1	53.1	46.9
	males	15.6	21.9	3.1	18.8	12.5	68.8
OG	females	40.7	3.1	.0	3.1	71.9	53.1
	males	37.5	3.1	.0	12.5	34.4	34.4
3) 5-y-o Children Upright stimuli							
Self	females	59.4	6.3	6.3	9.4	46.9	71.9
	males	34.4	28.1	15.6	21.9	40.6	81.3
SG	females	43.8	9.4	9.4	6.3	56.3	81.3
	males	40.6	9.4	.0	15.6	53.1	75.0
OG	females	71.9	3.1	3.1	12.5	62.5	71.9
	males	31.3	.0	3.1	12.5	46.9	65.6

As to the speed of response, the main results were as follows: no gender difference was observed across the three tasks. Quite obviously, the factor Presence (2 levels: only vs. no) was significant [F (1, 6) = 23.587, p = .003] with "noFeature" (mean RT = 1492 ms.) recognized faster than "onlyFeature" stimuli (mean RT = 1684 ms.). More interestingly, also the interaction Feature by Presence was significant [F (2, 12) = 4.170, p = .042] because the stimuli onlyEyes (mean RT = 1505 ms.) were recognized faster than both onlyMouth (1688 ms.) and onlyNose (1860 ms.) stimuli, while the opposite was true for noFeature stimuli with noEyes (1633 ms.) recognized slower than both noMouth (1441 ms.) and noNose (1402 ms.) stimuli.

Things were quite different when the performance with upside down stimuli was considered. Indeed, too many participants failed to fulfill the inclusion criterion requiring at least 50% of correct and reliable responses to any experimental stimulus, so their performance was analyzed only in terms of accuracy. Females were a bit more accurate than males and all the participants were overall more accurate in recognizing Self than SG and OG stimuli. Moreover, noFeature stimuli were recognized easier than only Feature ones. Notwithstanding this, no main factor nor any interaction was significant, indicating that all the differences tended to disappear with upside down stimuli.

5.1.2. Eight-Years-Old Children

Although 8-y-o children made much more errors than adults, their pattern of performance was very similar to that of older participants with no evidence of Gender or Task effect, but a high significance of the factor Presence [F (1, 6) = 210.162, p < .001] with noFeature (error rate = 10.9%) recognized much better than onlyFeature stimuli (error rate = 35.9%) and of the interaction Feature by Presence [F (2, 12) = 44.342, p < .001] due to the fact that onlyEyes (error rate = 8.3%) were recognized much better than both onlyMouth (43.2%) and onlyNose (56.2%) stimuli, while the opposite was true for noFeature stimuli with noEyes (25%) recognized much worse than both noMouth (6.8%) and noNose stimuli (1%).

5.1.3. Five-Years-Old Children

The pattern of 5-y-o children's performance was qualitatively undistinguishable from that of 8-y-o children, the only difference being the slightly larger number of errors made by younger participants. Thus, neither the factors Gender and Task, nor their interactions were significant. In turn, once again, the factor Presence [F (1, 6) = 99.954, p < .001] and the interaction Feature by Presence [F (2, 12) = 25.835, p < .001] were highly significant because 5-y-o children were much more accurate in recognizing noFeature (error rate = 19.3%) than only-Feature stimuli (error rate = 42.7%). Needless to say, the stimuli onlyEyes (error rate = 11.5%) were recognized much better than both onlyMouth (50.5%) and onlyNose (66.1%) stimuli, while the opposite was true for noFeature stimuli with noEyes (42.7%) recognized much worse than noMouth (9.9%) and noNose sti-

muli (5.2%).

Findings from experiment 3 were straightforward. The relatively bad performance of adult participants when requested to recognize upside down stimuli further demonstrates that inversion is especially detrimental to the processing of faces (Valentine, 1988), likely because disrupts local configural processing (Bartlett & Searcy, 1993; Boutsen & Humphreys, 2003). In turn, the performance of the three age groups with natural, canonical, upright stimuli, confirms that the facial feature "eyes" is recognized much better than the facial feature "mouth", which, in turn, is recognized better than the facial feature "nose". These results are strongly consistent with previous findings (Hay & Cox, 2000; Taylor et al., 2001; Pellicano et al., 2006; Ge et al., 2008) as well as with findings from experiment 2 claiming that the eyes are the most influential facial feature in the judgment of familiar, own-age, faces.

6. Conclusion

Three experiments were carried out to investigate how adults and children perceive whole faces, face and body parts.

Results were straightforward in demonstrating that adults are very expert at recognizing whole faces as well as and body and face parts of themselves and their friends. In particular, it was strongly emphasized the relevance of the eyes as the most influential facial feature (Hay & Cox, 2000; Taylor et al., 2001; Pellicano et al., 2006; Itier et al., 2007). Furthermore, at least when presented with very familiar stimuli and requested to perform quite ecological, relatively challenging, tasks, adult perceivers did not show any evidence of self effect (Keyes & Brady, 2010) nor of gender difference, thus failing to support the hypothesis of a female superiority in face processing (Cellerino, Borghetti, & Sartucci, 2004; McBain, Norton, & Chen, 2009; Sun, Gao, & Han, 2010). Finally, adults' performance with upside down stimuli confirms the deleterious effects of inversion upon face (and face parts) recognition (Valentine, 1988; Bartlett & Searcy, 1993; Boutsen & Humphreys, 2003).

This research, however, was mainly aimed at elucidating the abilities of children of different ages to recognize faces and facial features of themselves and their friends. A quite large sample of typically developing children from two age groups was enrolled in the study: 32 participants aged 5 years, and 16 participants aged 8 years. In both groups, females and males were equally distributed. Beyond the intrinsic limitations of a cross-sectional and not a longitudinal study, the results provided further insight into the developmental course of face and facial features processing. First, it was clear that, despite its early appearance, the expertise in face processing develops slowly over many years (Macchi Cassia, 2011) so that relevant behavioral differences emerge even when two narrow age cohorts are examined. In particular, while at 5 years of age children are already very able to recognize familiar, whole faces, they are still coarse and imprecise when requested to recognize body and face parts in isolation or—even in a lesser

degree—inserted into a face contour. This ability, however, improves during middle childhood, although 8-y-o perceivers still show a pattern of performance different from that observed among adults. Findings from this study are also clearly consistent with the hypothesis that the abilities to process the different internal facial features follow different, specific, developmental courses and processing of the eyes begins and matures earlier (Taylor et al., 2001), so that the eyes are much more influential than the mouth and the nose in identity judgments of familiar faces (Hay & Cox, 2000; Pellicano et al., 2006).

Given that self recognition seems to be present from 4 years of age (Frassinetti et al., 2012), one could have expected to observe a strong self-face effect among 5-y-o and 8-y-o participants with self-faces recognized easier and faster than other identities (Brédart, Delchambre, & Laureys, 2006; Keyes & Brady, 2010). Quite surprisingly, both 5-y-o and 8-y-o children turned out to be faster in recognizing SG and OG than Self faces. Far from disconfirming the presence of self recognition in the age cohorts under examination, this apparently paradoxical finding can be taken as supportive evidence of the idea that self-faces grab and maintain more attention than other identities, so that perceivers tend to look at their own face longer, rather than to find it faster (Devue et al., 2009).

A final consideration concerns gender differences in facial processing. Although, further investigation with a larger sample of participants is required to substantiate claims regarding a developmental advantage for female children in face processing, the trends seen in the data presented here seem quite robust. Previous observations are consistent with the hypothesis that the development of face processing abilities mainly depends on experience with faces rather than to age-related changes in face processing (Ge et al., 2008). Thus, it seems reasonable that face processing abilities mature earlier in females than males because females are more involved in human relationships and so more experienced with faces.

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Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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