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The Behavioral Relation of Classification and Attention for the perception of social stimuli

إعداد

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Abstract

In three Experiments, I used a modified visual search paradigm, to examine whether the red color singleton play any role in the perception of social stimuli such as faces, and body parts, and if both of them can capture attention, and differentiate between Active (i.e. hand & leg), and passive parts (torso). In the first experiment I presented either faces or body parts together with five different objects, but in the other experiments I presented active or passive parts with the same objects. Participants decided whether a randomly chosen target (surrounded by a green frame) belonged to a previously presented category. In half of the trials, an additional red frame surrounded a non-target singleton object was appeared. Consistent with earlier studies, participants responded faster to both face and body parts targets than to others, when faces or body parts appeared as singletons, they attracted attention and increased reaction times more than other objects, These results indicate greater attention capture by faces, and add evidence for similar mechanism for passive parts of the body parts.

Keywords: attention capture, face memory, body parts, Passive parts, Active Parts, a modified visual search paradigm.

Subject category: Behavioral and brain science.

Introduction

Social stimuli such as faces, and bodies are a unique type of stimuli, which not only provide a wealth of information, that facilities social communication but also capture attention (Huang et al., 2008; Theeuwes & Van der Stigchel, 2006; Langton et al., 2008), and have had many advantages in the visual system (Downing et al., 2004; Reed et al., 2004).

However, both of faces and body parts may be special and involuntarily processed (Farah, 1996).

Remarkably, there is an abundance of evidence demonstrating dedicated neuronal architecture for the processing of faces, and another dedicated neural architecture that, selectively responds to body parts (Downing et al., 2001; Peelen & Downing, 2005). However, the exact reasons for the existence of these cortical visual processing modules for these categories in specific are unknown, although one might speculate that having dedicated neuronal architecture for processing these biological stimuli would lead to some processing advantages.

Foregoing studies have mentioned that both of these categories have a distinct or specialized neural representation may also be given priority for attentional selection (de Haan et al., 2002). It is not clear whether attention priority for faces and bodies is a consequence of neural specializations for these categories

(Downing et al., 2004). Might be there is general mechanism guide visual attention to faces and bodies, leading, over the course of development, to specialize focal representations of these stimuli.

In one of studies, which reported the attentional biases for faces and body parts, showing that body parts like faces, can be rapidly and efficiently processed, and may be bias and engage the attentional system more than other types of objects (Ro et al., 2007). But in this study the authors were used one experiment, using body parts compared to three experiments, using faces to prove the relation between faces and bodies, but this comparison is not clear cut. Therefore, here I tried to replicate the same findings in above mentioned study, by using the same paradigm, which based on the idea that, one item in the display is the target singleton, whereas another singleton is completely unrelated and irrelevant to the task (Theeuwes, 1991; Theeuwes, 1992; Theeuwes, 1994; Theeuwes & Burger, 1998) by including both categories in the experiment. Thus in the current study I examined:

- Whether faces or body parts are processed differentially?
- Whether faces and body parts are engaged the attention with the same degree?
- Would the presentation of different parts of the body parts influence of the speed of processing these parts or not?

- Whether the dynamic parts such as hands would engage attention with greater extent compared to non-dynamic parts such as torso or not?
- Would the inversion effect influence on the processing of these stimuli and capture attention or not?

Experiment 1

In this Experiment I replicated the same aims in previous study of (Ro et al., 2007), including faces and body parts in one Experiment, and do not compare between different experiments as (Ro et al., 2007) have done in abovementioned study to examine:

- Whether faces or body parts might be processed faster than other objects?
- Whether faces or body parts may interfere more with target processing when presented as a distractor?

Method

Participant:18 participants (9 males) Age between 19 and 27 years old (*M*= 22.9), and all of them reported normal or corrected to normal vision.

Stimuli and apparatus:

In the practice trials: ***70*** photographs of ***7*** categories (faces or body parts, houses, mobile phones, tools, vegetables and birds) [1].

[1] We adjusted as possible as best the main properties of the images that we used in our Experiments, and there wasn't any differences between contrast and luminance or mean amplitude all *ps* > 0.1

In the main experiment: ***350*** photographs of the same ***7*** categories. Faces pictures were obtained from CAL_PAL_Database (Minear & Park, 2004), others were obtained from different sources and were edited using Adobe Photo shop (version 9.02). All images were converted to grey scale and placed in front of black background. Horizontal and vertical stimulus size was **130×130** Pixels for all categories. A fixation white cross presented in the display centre was used as a fixation point, the category names were presented in white, Arial Bold **26** point font. Each object in the visual search display was presented in the grey scale on the square black background that measured 3.6º of visual angle from a viewing distance of 90 cm.. An outline frame that has 5 º widths surrounded each objects, and was Red, Green or Blue. This experiment was conducted on a personal computer, set at a 1024 x 768 pixel resolution, and the colour quality is 32 bit. The distance between the participants and the monitor screen was kept using chain rest. Responses were made on a two-button response keyboard.

Procedure

I used the identical procedures as (Ro et al., 2007) have been described in his study to compare between the results which have been obtained from the above mentioned study, and include faces and body parts in the same experiment. However, the number of trials in this experiment are 672 trials (336trials contain faces, with five other categories only, half of them including red color singleton), which organized on 8 blocks and 4 minutes break after each block [for more details on design see fig.1 below].

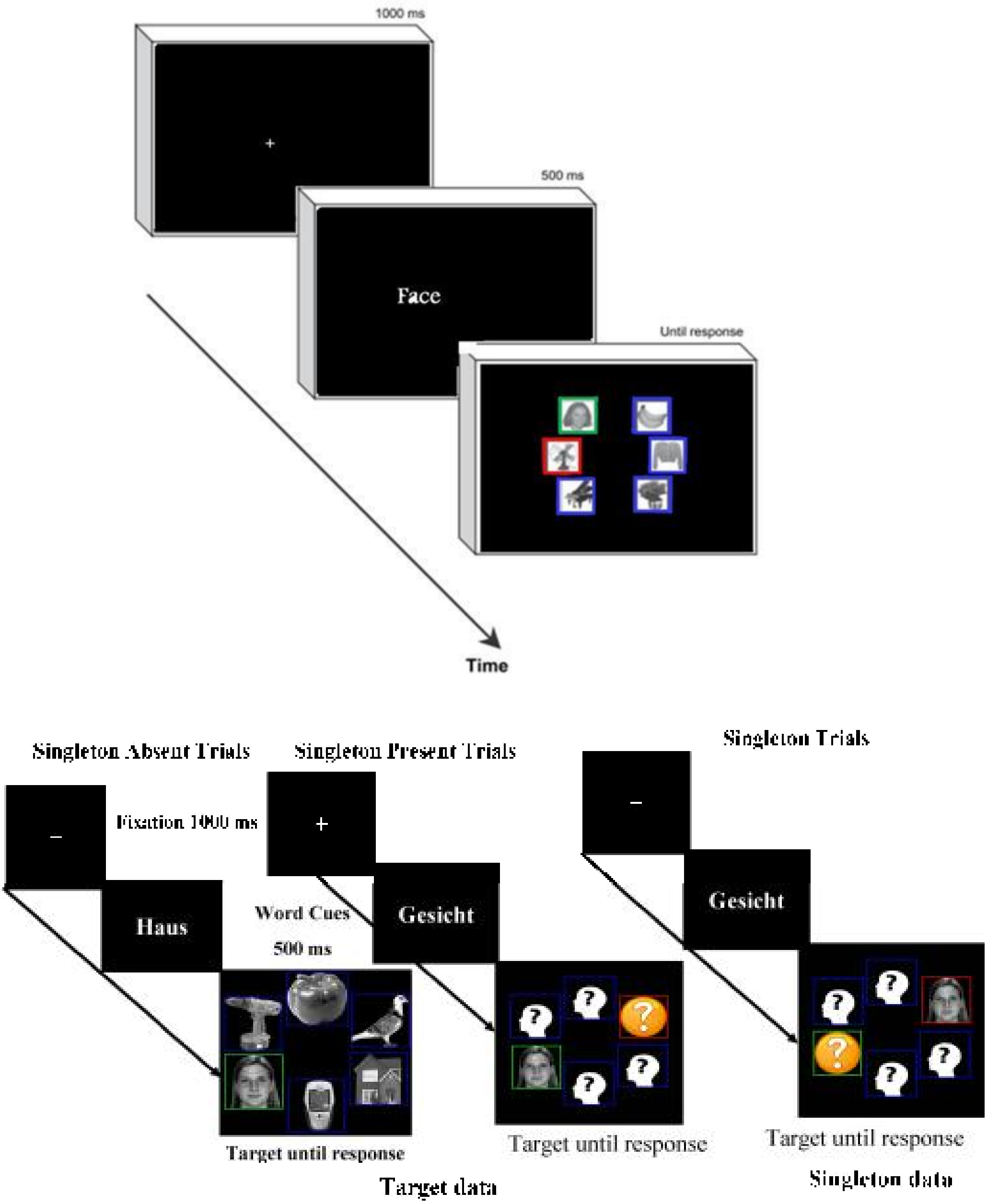

Fig1.An example of the sequences of stimulus events on atypical trail of the Experiment

Data Analysis

I used factorial design and calculated the correlation between variables and subjects using Multi ANOVA to investigate the effect of Red color singleton (2 level), object category, (7 levels), and response (2 level).

Results

Accuracy:

A three way ANOVA with and within-subject factors of target response , target-object category TOC and singleton revealed main effect of interaction category and response $F(6,102)=4.7$; $p<0.01$. The effect of singleton present was marginally significant $F(1,17)=3.1$; $p=0.09$, these results revealed that the errors rate increased when the colour singleton present.

RTs:

I used the outliers' correction to keep the homogeneity of the RTs of all subjects. A three- way ANOVA revealed a main effect of target response, $F(1, 17)=145$; $p<0.0001$: "yes" responses (*M*= 629,2) were faster than "No" responses (*M*=690,6), and main effect of TOC $F(6, 102)=12,7$; $p<0.01$.

I collapsed singleton presence, and response to see the effect of each category type, *F*-Contrast revealed that response were faster when the object was a face (*M*=623.4 ms), compared to the other objects combined (*M*=662.98 ms), $F(1, 17)=11.2$; $p< 0{,}01$. For body parts, *F*-contrast revealed a marginally effect of response when the object were a body parts (*M*=641.2 ms), compared to the other objects combined (*M*=662.98 ms), $F(1, 17)=3{,}98$; $p= 0{,}06$, also *F*-Contrast revealed a significant effect of response when the object was a face (*M*=623.4 ms), compared to body parts (*M*=641.2 ms), $F(1, 17)=14.1$;$p< 0{,}01$. However, these results confirm the idea that faces have had a classification advantages compared to body parts. A significant interaction between target response and target object, $F(6, 102)= 23.8$, $p<0.01$, showed that the effect of response was different between the target objects, and also there was interaction between response and singleton present $F(1, 17)=13{,}9$; $p<0.01$,these results showed that the effect of response were slower when the singleton present versus absent, and also there was interaction between objects and singleton $F(6, 102)=3{,}7$; $p<0.05$, these results indicated that the singleton affect in a different way on each objects type.

Target Category	**Singelton Absent**		**Singelton persent**	
Response (RTs)	Yes	No	Yes	No
Faces	579 (22.41)	672 (28.91)	600 (24.40)	727 (30.91)
Body Parts	601 (23.49)	676 (29.07)	640 (28.59)	730 (32.73)
Birds	644 (25.64)	697 (28.99)	663 (26.97)	739 (31.89)
Vegetables	664 (28.82)	703 (30.75)	711 (29.62)	748 (33.64)
Houses	607(25.41)	704 (31.01)	645 (24.38)	759 (34.71)

Cell phones	631(24.07)	696 (29.41)	663 (25.32)	746 (32.96)
Tools	684 (22.68)	693 (30.42)	722 (27.36)	745 (31.02)

Table1. The Mean RTs and SEM for all of the categories used in the experiment

I collapsed singleton presence to examine if there are differences between categories. *F*-Contrast revealed that, "No" response in body parts (*M*=661.8) faster than other objects combined (*M*=695.4), $F(1, 17) = 7.6$; $p < 0.05$, but in faces (*M*= 666,6), this effect was marginally faster than other objects combined (*M*=695.4) $F(1, 17) = 3.7$; $p = 0.07$, but there wasn't any differences between faces and body parts. For "Yes" response faces (*M*= 580.1) faster than other objects combined (*M*=630.6), $F(1, 17) = 25.5$; $p < 0.01$, but in body parts (*M*=620.7) I did not find any differences with other objects combined (*M*=630.6), $F(1, 17) = 0.8$; $p = 0.4$, but I found that faces (*M*=580.1) faster than body parts (*M*=620.7), $F(1, 17) = 31.3$; $p < 0.01$. In the line with attentional capture findings (e.g., Theeuwes, 1994; 1996), RTs were slower when the singleton present (M=687.8) than when it was absent (*M*=631.9), $F(1, 17) = 4{,}2$; $p = 0{,}056$.

To further examine the singleton effect I entered target RTs in the singleton trials into a two-way ANOVA with the within-subject factors of target response (2-Levels) and singleton category (7-Levels; see Figure 2, Right panel). This ANOVA showed a main effect of target response, $F(1, 17)= 35.2$; $p <0.001$, again reflecting faster "Yes" responses (M=656.9) than "No" responses (M=706.1). There was also a main effect of singleton category, $F(6, 102)= 11.8$; $p <0.01$. I collapsed the response to see the effect of for each singleton category, F-Contrasts revealed that the target response were slower when the singleton was a face (M=712.1), as compared to other objects combined (M=671.8), $F(1, 17)= 50.7$; $p <0.001$, and again a similar effect for body parts (M=699.6), as compared to other objects combined (M=671.8), $F(1, 17)= 25.2$; $p <0.001$.When the five non-face/ non-body singleton categories were compared to the other combined singleton categories, only vegetables were

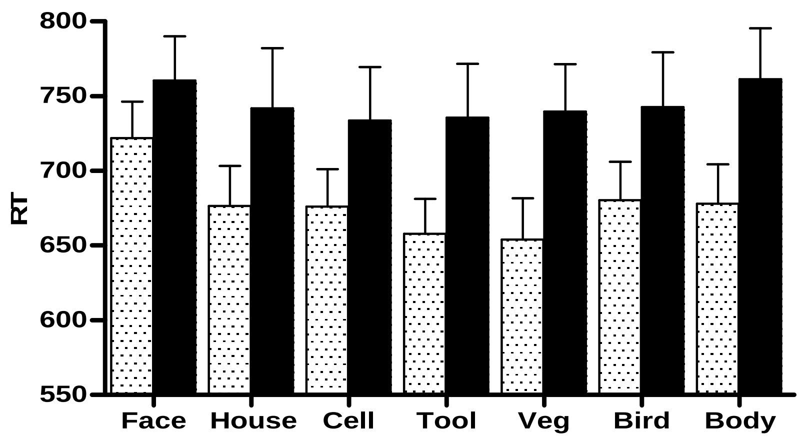

Fig.2. The mean RTs coded by singleton category, on singleton present trials. White bars indicate the RTs on "Yes" Response trials; black bars indicate the RTs on "No" response

significantly faster (unlike faces, which were slower when in the singleton) than the other objects, F(1, 17)=5.9, *p*<05, all other Fs<1, all ps>.30. The interaction between response and singleton category was marginally significant, $F(6, 102)= 3.1$; p =0.07. It might be that the stronger effect of singleton for faces or body parts, and that's may have simply due to the fact that there was faster response when the target was a faces, or body parts but when faces or body parts as a singleton, they lead to increase the RTs compared to other objects combined. To address this issue, I conducted additional analysis comparing RTs in the presence of faces or body parts in the singleton location compared to other object categories, Face Singletons still produced the slowest responses in this analysis (*M*=712.1 ms for faces vs. *M*=671.8 ms for other objects), t(17)=7.1, p<0.05.A gain body part Singletons still produced the slowest responses in this analysis (*M*=699.5 ms for body parts vs. *M*=671.8 ms for other objects), t(17)=5, p<0.05..

Discussion

These results not only in line with previous studies, which attributed to a perceptual advantage in face recognition (Farah et al., 1998), but also introduce a new evidence for a similar mechanism for body parts. However body parts were classified faster than other objects combined, but faces are still have had many of advantages compared to body parts as revealed in the significant effect of the comparison between faces and body parts. Also I have shown that faces and body parts are a special type of stimuli that engaged, and hold attention more than other objects

These findings suggested that there is a special mechanism that be operating that, distinguish these complex biological stimuli (faces and body parts) from other objects. Another possible mechanism is a bias towards animate as compared to inanimate objects(Ro et al., 2007). In this Experiment I used a mixture of active and passive parts, so in the Experiment 2 I will try to distinguish the differences between Active parts (e.g. extremities i.e., hands and legs) and Passive parts (i.e. Torso) to see which parts could capture attention more than the others?

Experiment 2

In this experiment I try to differentiate between active and passive parts and show, which category has a classification advantages and more attention capture than others. I used identical procedures as in Experiment 1, EXCEPT that in this experiment, I used dynamic (e.g., hands and legs) and non-dynamic parts (e.g., Torso) of body parts, instead of faces and mixture of body parts to answer the following questions:

- Would Active or Passive parts produce larger singleton costs than other objects?
- Would active or passive parts produce a greater facilitation when in the target frame?

Results

Accuracy

A three way ANOVA with the within-subject factors of target response TOC and singleton revealed a main effect of target category, $F(6, 102)=5.6$, $p<0.01$. To see the effect of passive parts as target and active parts I collapsed non-body objects together. *F*-Contrast revealed that, the error rates for determining whether or not Passive parts belonged to the cued category were less than for determining exemplars from other categories combined, $F(1, 17)=4.9$, $p<0.05$. Interestingly active parts error rates did not differ significantly compared to others objects combined $F(1, 17)=0.34$, $p<0.7$, but there are significant differences between active and passive parts $F(1, 17)=6.7$, $p<0.01$.

RTs.

I used the outliers' correction to keep the homogeneity of the RTs of all subjects. A three- way ANOVA revealed a main effect for target response, $F(1, 17)=59.4$; $p<0.001$: "yes" responses (M= 622,9) were faster than "No" responses (M=677,4), and main effect of TOC $F(6, 102)=14,8$; $p<0.01$.

I collapsed singleton presence, and response to see the effect of each category. *F*-Contrast revealed that response were faster not only when the object was Passive (*M*=627.2ms), compared to the other objects combined (*M*=653.9 ms), $F(1, 17)=59.3$; $p< 0,001$, but also for Active parts, (M=640.8 ms), compared to the other objects combined (M=653.9 ms), $F(1, 17)=6,4$;$p< 0,05$. F-Contrast revealed a significant effect of response when the object was Passive parts compared to Active parts $F(1, 17)=7{,}6$;$p< 0{,}05$. these results proved that Passive parts have had a classification advantages compared to Active parts. A significant interaction between target response and target object category, $F(6, 102)= 8$, $p<0.01$. To investigate which category is faster than other, I collapsed the singleton presence, *F*-Contrast revealed that, "No" response in Passive parts (M=659.5) faster than other objects combined (M=681.6), $F(1, 17)= 20.6$; $p<0.01$, but this effect was not significant in Active parts (M= 674.3 ms), (M=681.6 ms), $F(1, 17)= 2.9$; $p=0.10$, but *F*-Contrast revealed that, Passive parts were faster than active parts $F(1, 17)= 5.6$; $p<0.05$. For "*Yes*" response Passive parts (M= 594.8) faster than other objects combined (M=626.1 ms), $F(1, 17)= 20.5$; $p<0.01$, and again Active parts (M=635.3 ms) did not differ from other objects combined (M=626.1 ms). These results indicated that passive parts have a classification advantages compared to Active parts.

In the line with perceptual selectivity findings (e.g., Theeuwes, 1994; 1996), RTs were slower when the singleton present (M=662.7 ms) than when it was absent (M=637.6 ms), $F(1, 17)=32.9$; $p<0{,}001$.

Target Category	**Singelton Absent**		**Singelton Persent**	
Response (ms)	**Yes**	**No**	**Yes**	**No**
Passive parts	**579 (20,59)**	**658 (22,45)**	**615 (23,88)**	**676 (25,27)**
Houses	**580 (21,95)**	**665 (22,37)**	**606 (24,71)**	**696 (30,77)**
Cell-phones	**595 (22,70)**	**673(25,39)**	**624 (24,62)**	**690 (25,21)**
Tools	**636 (21,20)**	**680 (24,34)**	**668 (26,03)**	**692 (25,89)**
Vegetables	**641 (22,64)**	**679 (25,63)**	**659 (24,14)**	**708 (25,17)**
Birds	**608 (21,30)**	**662 (26.01)**	**633 (23,89)**	**693 (28,69)**
Active parts	**628 (22,90)**	**661 (23,68)**	**646 (21,53)**	**691(27,91)**

Table 2. The Mean RTs and SEM for all of the categories used in the experiment

To further examine the singleton effect I entered target RTs in the singleton trials into a two-way ANOVA with the within-subject factors of target response and singleton category, the results revealed a main effect of target response, $F(1, 17)= 31.1$; $p<0.001$, again reflecting faster “Yes” responses (M=636.6) than “No” responses (M=690.1). There was also a main effect of singleton category, $F(6, 102)= 3.8$; $p<0.05$. I collapsed the response effect to differentiate the effect of each singleton category, *F*-Contrasts revealed that the target response were slower when the singleton were Passive parts (M=684.5), compared to other objects combined (M=658.4), $F(1, 17)= 29.1$; $p<0.001$, again active parts (M=677.3),did not differ significantly compared to other objects combined (M=658.4), $F(1, 17)= 1,6$; $p=0.2$, but there was a main effect between passive parts and active parts, $F(1, 17)= 8.5$; $p < 0.0$, these results revealed that, passive parts capture attention more than active parts.

Discussion

The findings showed that Passive parts are a special type of stimuli that engaged, and hold attention more than other objects, and produce a similar mechanism like faces, and attracted attention more than other objects combined. It therefore might be argued that the attentional Capture effects that I measured with Passive parts may have been due to the inclusion of a category that was less attention engaging than others or less typical of a category than the other categories used. One hint here comes from *fMRI* studies that showed a strong response to the torso, and of relatively strong selectivity for arms (vs. branches) compared to hands or fingers (Taylor et al., 2007).

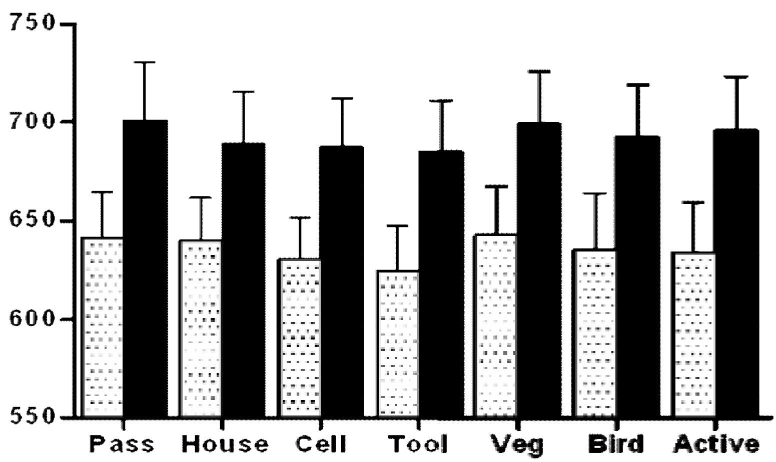

Fig.3. The mean RTs coded by singleton category, on singleton present trials. White bars indicate the RTs on “Yes” Response trials; black bars indicate the RTs on “No” response

General Discussion

Our findings raised the hypothesis that, those stimuli that have distinct or specialized neural representations may be also given priority for attentional selection. Here I used a modified visual search paradigm developed by (Ro et al., 2007) to test the hypothesis for the case of the images of the body parts or faces (Experiment1) or only body parts “active vs. passive” (Experiment2) to investigate whether theses biological stimuli (Faces and bodies) have had a classification advantages when they be in the target location (See Figure1part a and b), or more attention capture when they be in the singleton location(See Figure1 part c). The results provided not only faces, the only category, which have had a classification advantages, but also passive parts (i.e. Torso) showed the same effect when I presented it right side up (Experiment 2). These findings still in line with previous studies,that demonstrating dedicated neural architecture for the Processing of faces and body parts (Taylor et al., 2007; Peelen & Downing, 2007; Downing et al., 2004; Peelen & Downing, 2005), which suggested a new mechanism for analyzing faces and body parts, and adding a new evidence that there are differences between active and passive parts, which produced a similar effect like faces.

It is important to note that our findings reconciled with another study (Ro et al., 2007) which found that, faces and body parts compared to other objects have had a classification advantages and more attention capture than other objects combined. Here I replicated the same results in above mentioned study, but interestingly I found a significant differences between faces and body parts in a classification task, and hold attention tasks, and may be these findings due to that I were including faces and body parts in one Experiment, one hint here come from *fMRI* study that show that the middle occipital gyrus (OMG), and surrounding regions that encompassed the reported locations of EBA were most strongly activated when the torso and limbs were visible and weakest when only the face was visible (Morris et al., 2006), and may be the presence of the face lead to inhibit or delay the response time in the next trials when the body parts appeared (you should notice that I randomized all the trials, and the participants see only faces or body parts).

Another novel and counterintuitive findings have shown in the experiment two when passive parts classified faster than others objects, and attracted attention more than other objects when it had been in the singleton location, these findings in line with *fMRI* studies which reported a strong response to the torso, and of relatively strong selectivity for arms (vs. branches) compared to hands or fingers (Taylor et al., 2007) for more details see also (Op de Beeck et al., 2008; Peelen & Downing, 2007), these results presented behavioral evidence for the findings that the *fMRI* Studies found it.

Hence, the faster responses to face and body part targets and the slower responses to other targets when faces and body parts are in distractors suggest that faces and body parts produce a larger magnitude of attentional dwell than other types of objects(Ro et al., 2007). Although participants were instructed that the singleton frames and the objects within them were to be ignored, certain objects within these singletons significantly affected the response times and error rates to spatially displaced targets. This finding, along with several other findings using this paradigm (Theeuwes, 1994, 1996; Theeuwes & Burger, 1998), demonstrates that once a stimulus is captured by attention, in this case the colour singleton frame, the attended stimulus may be processed regardless of whether or not it is task relevant. However, our results demonstrating that faces and body parts within the singleton frames affected performance on the task more than other objects suggests, in conjunction with several other behavioural and neuropsychological results (Farah, 1996), that faces and body parts may be special and obligatorily processed. that might be responsible for the attentional engaging properties of faces and body parts is a bias towards animate as compared to inanimate objects (Ro et al., 2007).

All of these findings suggest new mechanism analyzing faces and body parts, and added another mechanism for the processing of passive parts.

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