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Decisional space determines saccadic reaction times in healthy observers and acquired prosopagnosia

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ABSTRACT
Determining the familiarity and identity of a face have been considered as independent processes. Covert face recognition in cases of acquired prosopagnosia, as well as rapid detection of familiarity have been taken to support this view. We tested P.S. a well-described case of acquired prosopagnosia, and two healthy controls (her sister and daughter) in two saccadic reaction time (SRT) experiments. Stimuli depicted their family members and well-matched unfamiliar distractors in the context of binary gender, or familiarity decisions. Observers' minimum SRTs were estimated with Bayesian approaches. For gender decisions, P.S. and her daughter achieved sufficient performance, but displayed different SRT distributions. For familiarity decisions, her daughter exhibited above chance level performance and minimum SRTs corresponding to those reported previously in healthy observers, while P.S. performed at chance. These findings extend previous observations, indicating that *decisional space* determines performance in both the intact and impaired face processing system.

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Introduction

In our everyday life we are constantly surrounded by both unfamiliar and familiar individuals. Smooth social interactions depend on our ability to perform a range of different subprocesses associated with face cognition. We need to *detect* the presence of a face, *discriminate* between individuals, *recognize* whether someone is familiar or not, and finally *identify* others at the individual level. In the healthy brain, these subprocesses are usually achieved with high proficiency across a range of constantly changing conditions (Ramon, 2015; Ramon & Gobbini, 2017). Cognitive and neurofunctional models suggest that these subprocesses are distinguishable and are subserved by distinct neural substrates and mechanisms (Besson et al., 2017; Bruce & Young, 1986; Duchaine & Yovel, 2015; Haxby, Hoffman, & Gobbini, 2000).

Individuals suffering from prosopagnosia—the impairment in face processing either caused by brain damage or without any neurological history (Corrow, Dalrymple, & Barton, 2016; Geskin & Behrmann, 2018; Rossion, 2014)—provide a unique means to investigate and characterize these different subprocesses of face cognition (Ramon, 2018). For instance, studies reporting impaired processing of identity and spared processing of facial expressions in cases of prosopagnosia (for a recent review see Bate & Bennetts, 2015) have been taken to support the view that processing of identity and expressions are independent (but see recent psychophysical findings contesting this view, e.g., Fiset et al., 2017; Richoz, Jack, Garrod, Schyns, & Caldara, 2015). Similarly, familiarity recognition and face identification, which rely on different diagnostic information (e.g., Smith, Volna, & Ewing, 2016), have also been suggested to be independent. For instance, studies of acquired prosopagnosia measuring autonomic responses have suggested covert recognition of faces that could not be overtly identified (Tranel & Damasio, 1985). Recent behavioural evidence from the well-described acquired prosopagnosic patient, P.S. (Rossion, 2014; Rossion et al., 2003), demonstrates that performance for familiarity recognition is superior to that observed for face identification (Ramon, Busigny, Gosselin, & Rossion, 2017).

Concerning the distinction between subprocesses involved in face cognition, one important aspect has, in our opinion, received insufficient attention: the

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role of task-dependent and procedurally determined stimulus predictability, or *decisional space* (Ramon, Busigny et al., 2017; Ramon, Sokhn, & Caldara, 2017; Ramon et al., 2018a). For example, face detection and identification not only rely on discrete diagnostic information, but moreover involve categorizations performed within a decisional space of varied breadth. To illustrate, gender decisions that are of binary nature (male, female) lead to a highly constrained decisional space, which is independent of the total number of identities presented throughout an experiment. Categorization of facial expressions involves a comparatively broader decisional space, given the number of possible expressions (cf. universally recognized expressions; Jack, Sun, Delis, Garrod, & Schyns, 2016). For face identification, the decisional space is profoundly enlarged; it involves determining the identity of one of numerous familiar individuals for which facial representations stored in memory exist. Moreover, such task-related decisional space constraints interact with procedural aspects related to the employed experimental design. For example, if a task requires observers to identify one individual from a previously communicated pool of only three familiar identities, the decisional space will be smaller than if the pool comprised a total of 100 familiar faces. Consequently, the operational decisional space is constrained not only by the responses required by a task, but also by the number of possible exemplars that can act as priors to guide and facilitate categorical decisions.

Therefore, it is imperative to bear in mind that procedural choices made by experimenters can change the nature of the task, even when the required overt decision provided by observers remains the same. To illustrate, Matthey et al. (2012) and Visconti di Oleggio Castello and Gobbini (2015) both conducted saccadic reaction time (SRT) experiments, in which observers were required to perform choice saccades towards familiar face stimuli presented laterally together with an unfamiliar face distractor. On the surface both studies appear to probe the same mechanism—familiar face recognition—measured through the same (binary) oculomotor response. However, these studies differ regarding one important aspect: the total number of target identities. Observers in Mathey et al.'s (2012) study performed choice saccades towards (non-repeated) images of Nicolas Sarkozy, while those in Visconti di Olleggio Castello and Gobbini's (2015) study saccaded towards three target identities. That is, observers performed a search task, in which they responded to a *single* or *three* predefined targets, leading to differences in the breadth of their operational decisional space. Interestingly, Visconti di Oleggio Castello & Gobbini (2015) reported minimum SRTs of 180 ms and modest overall accuracy (62%) despite several hundreds of image repetitions (which can lead to a decrease in minimum RTs; Ramon, Caharel, & Rossion, 2011). Mathey et al. (2012) on the other hand reported minimum SRTs of <140 ms with 60–75% performance accuracy. To summarize these independent findings, in the context of the same task ("Saccade towards familiar faces" or "Lift your finger when you see a familiar face"), searching for *one target*, as opposed to *three* target identities (i.e., a relatively more constrained operational decisional space), was associated with higher performance accuracy *and* faster responses.

Recently, we directly investigated the relationship between decisional space constraints and saccadic choice behaviour. First, in line with previous reports (Besson et al., 2017; Visconti di Oleggio Castello & Gobbini, 2015), we found that only about 50% of healthy participants were capable of performing choice saccades towards personally familiar faces (Ramon, Busigny, et al., 2017; Ramon, Sokhn, et al., 2017; Ramon et al., 2018a). Moreover, we demonstrated that healthy observers' performance for familiarity decisions indeed depends on the number of expected target identities: SRTs decreased, and performance accuracy increased with fewer potential target identities. Importantly, we failed to replicate the previously reported "familiar face detection in 180 ms", which we believe represents an estimate of the time required to perform 1-of-3 *target identity decisions* (cf. Besson et al., 2017; Mathey et al., 2012), rather than supporting the conclusion that "rapid detection . . . precedes explicit recognition of identity" (Visconti di Oleggio Castello & Gobbini, 2015, p. 1).

Related to acquired prosopagnosia, previous work emphasizes the impact of prior knowledge in modulating observed performance through decisional space constraints. In the original report, the patient P.S. (Rossion et al., 2003) was—despite being impaired—indeed *capable* of discriminating faces based on gender and facial expressions, achieving about 80% for both tasks. Familiarity decisions, on the other hand, were more difficult: Presented with a set of 60 famous and 60 unfamiliar individuals, P.S. responded correctly for all unfamiliar faces, but for only 14 of the famous items (four for whom she provided correct semantic details). Further evidence stems from a recent study of P.S., involving an extensive battery of tasks that utilized face stimuli of children that P.S. supervised as a kindergarten teacher (Ramon et al., 2017). P.S. performed well above chance, although her performance depended on the stimulus format: She correctly identified 87% (natural/colour) and 46% (cropped/greyscaled) of the total of 27 children's faces (Experiment 1). More impressively, she achieved 75% when one of the set comprising 16 individuals had to be identified among highly controlled (cropped/colour) and challenging morph face stimuli (Ramon et al., 2017; Experiment 2).

Thus, tasks (i.e., type of categorization required) *and* procedures (e.g., number of targets, available information, etc.) affect operational decisional space and influence performance in both healthy and—probably even more so—brain-damaged individuals. Adding to the aforementioned findings from acquired prosopagnosia (Ramon et al., 2017; Rossion et al., 2003; see also Ramon & Rossion, 2010, for similar procedural modulation in unfamiliar-face-matching tasks), recent evidence from B.C., a rare case of complete cortical blindness, supports this idea. Ruffieux et al. (2016) found that B.C. could not identify *individually presented* point-light walkers displaying biological and non-biological motion; however, in a two-alternative forced-choice scenario, he could accurately indicate the location of the walker depicting biological motion (for a discussion, see Ramon, 2018). Insufficient consideration of these important interactions between task- and procedure-related decisional space constraints, together with a lack of precise terminology, can lead to erroneous conclusions, which can hinder progress regarding understanding of normal behaviour, and moreover have dramatic implications for patient diagnosis and intervention (Ramon, 2018). Therefore, to advance our knowledge of healthy cognition and neuropsychological disorders, we need to consider and explore the parameters that govern task- and procedure-related differences in human performance.

Building on previous neuropsychological findings of task- and procedure-dependent performance in patients, the present study sought to investigate whether deficits displayed in prosopagnosia vary as a function of operational decisional space constraints. To this end, we employed a previously established saccadic choice paradigm (Mathey et al., 2012; Ramon, Busigny, et al., 2017; Ramon, Sokhn, et al., 2017; Ramon et al., 2018a; Visconti di Oleggio Castello & Gobbini, 2015) to address this question systematically with high temporal precision. In two experiments, observers performed binary gender or familiarity decisions by performing choice saccades towards predefined target faces. Three observers—P.S., her sister, and her daughter—were required to saccade towards female faces (gender categorization task), or personally familiar identities (three family members; familiarity categorization task), which were presented parafoveally together with a well-matched distractor stimulus. In line with our previous observations (Ramon, Sokhn, et al., 2017; Ramon et al., 2018a), we anticipated that healthy observers who achieve above-chance performance for familiarity categorizations would show comparatively superior performance (SRTs, accuracy) for gender decisions, due to the difference in breadth of operational decisional space across tasks. We were particularly interested in determining whether decisional space constraints would have a similar effect on P.S.'s performance. If she were unaffected by task-and procedure-related top-down priors, she should exhibit comparable (at or above chance) performance levels across both tasks. However, if such priors are effective in facilitating behaviour, P.S. should perform best for gender decisions.

Method

Participants

We tested three subjects: P.S., her sister, and her daughter, who were 66, 60, and 41 years old at the time of testing. All subjects live in close proximity and see each other on a daily basis. P.S.'s daughter and sister have no complaints of face recognition. Participants provided written informed consent; all procedures were approved by the internal ethics committee of the Department of Psychology at the University of Fribourg (Switzerland), and are in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki).

Stimuli

The full stimulus set comprised natural (uncropped, colour) images of 20 facial identities (10 unfamiliar, 10 familiar) taken from three different viewpoints (frontal, left, right). For each personally familiar identity, images of a corresponding unfamiliar identity carefully matched for age, gender, and appearance (hair colour and style, eye colour) were taken. Image processing included placement on a uniform grey background (630 × 630 pixels) and correction for low-level properties (luminance, contrast) using the SHINE toolbox (Willenbockel et al., 2010) and additional code kindly provided by V. Willenbockel.

Procedure

For both experiments, stimuli were presented on a 1,920 × 1,080-pixel VIEWPixx monitor. Subjects' oculo-motor behaviour was recorded at a sampling rate of 1,000 Hz with an SR Research Desktop-Mount EyeLink 2K eye-tracker (with a chin and forehead rest; average gaze position error ∼0.5, spatial resolution: ∼0.01). The eye-tracker had a linear output over the range of the monitor used. Although viewing was binocular, only the left eye was tracked. The experiment was implemented in Matlab (R2009b, The MathWorks, Natick, MA), using the Psychophysics Toolbox (PTB-3; Kleiner, Brainard, & Pelli, 2007; Pelli, 1997) and EyeLink Toolbox extensions (Cornelissen, Peters, & Palmer, 2002; Kleiner et al., 2007). Calibrations of eye fixations were conducted at the beginning of the experiment using a nine-point fixation procedure as implemented in the EyeLink API and using Matlab software. Calibrations were validated with the EyeLink software and were repeated when necessary until reaching an optimal calibration criterion. Drift correction was performed on each trial via central cross fixation. These experimental parameters were identical to those adopted in a previous study involving saccadic gender and familiarity decisions in young healthy observers (Ramon, Sokhn, et al., 2017; Ramon et al., 2018a).

In the *gender categorization task*, subjects were instructed to perform choice saccades towards female faces between the pair of faces presented on each trial. In this task, three images (depicting different viewpoints) for each of the 16 individuals (eight personally familiar and unfamiliar identities; four females per group) were used. Figure 1 illustrates the general procedure; a trial began with a central fixation cross displayed between 800 and 1,600 ms, followed by a 200-ms blank and subsequent presentation of the target/distractor pair (same viewpoint) presented for 600 ms. After a saccade was registered, the next trial was presented after a 1,000-ms blank inter-trial interval. Stimuli subtended 14° × 14° of visual angle (the face region subtending on average 11° of visual angle); stimulus eccentricity was 8.6̊ of visual angle. With all possible combinations and equal number of presentations per identity and visual field, the total number of trials was 384; subjects took self-paced breaks after each block of 64 trials.

For the *familiarity categorization task* we used three images (depicting different viewpoints) for each of the six individuals (three personally familiar males and well-matched unfamiliar male distractors). Presentation parameters were identical to those described for the gender categorization task (see above); on each trial observers were required to saccade towards the personally familiar face (cf. Figure 1).[1] On each trial, a personally familiar identity was paired with a same-gender, same-viewpoint distractor, and appeared with equal probability in either visual field. The total number of trials amounted to 324. Subjects took self-paced breaks after each block of 54 trials.

Analyses

Preprocessing

We applied the adaptive velocity based algorithm developed by Nyström and Holmqvist (2010) to find the onset of the first saccade within each trial. For the descriptive statistics reported, we discarded trials in which the onset of the first saccade was lower than 80 ms (Visconti di Oleggio Castello & Gobbini, 2015), as these were considered anticipatory saccades. Note that *all* trials were considered for the density estimation analysis using the Drichlet process described below.

Statistical analyses

Given our interest in the effect of task/decisional space on SRTs on the single-subject level, we modelled the SRT time course for each individual. Analyses on SRTs typically involve multiple hypothesis testing performed on arbitrary time bins. For example, in

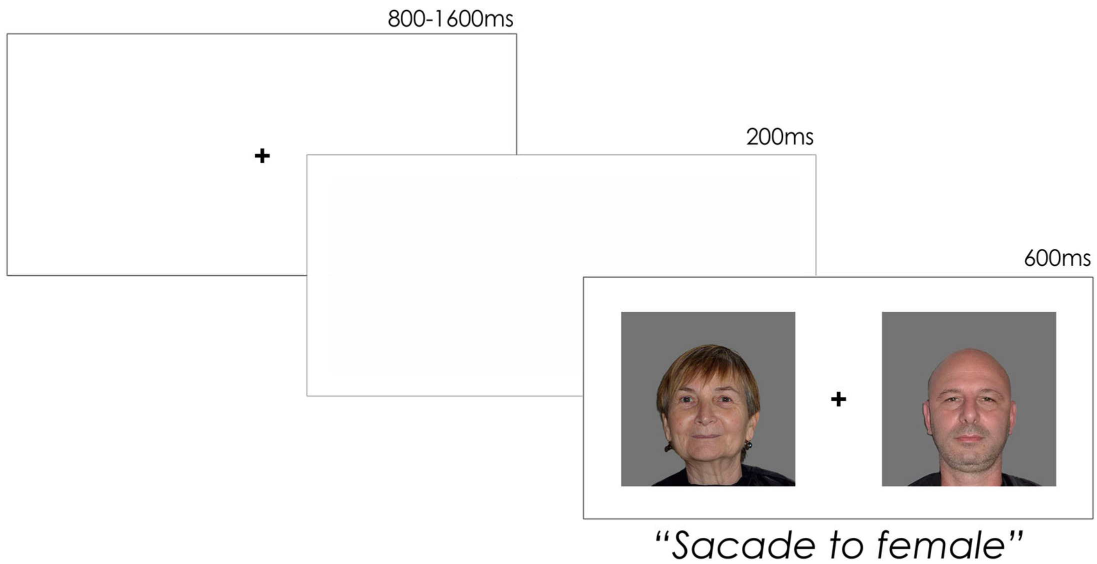

Figure 1. Experimental procedure for the saccadic reaction time experiments. Displayed here is a typical trial from the gender categorization task. For the familiarity categorization task, each trial depicted a personally familiar face target paired with a same-gender unfamiliar face distractor. Individuals depicted provided written consent for image publication.

Rousselet et al. (2003), the RT distribution was binned using a non-cumulative histogram with 10-ms time bins; a χ^2 test with a $p < .001$ threshold was then applied at each time bin to determine the minimal behavioural processing time at the group level (see also e.g., Bacon-Macé, Kirchner, Fabre-Thorpe, & Thorpe, 2007). However, such an approach would be inappropriate here; given the inherently larger amount of noise characteristic of single-subject data, the estimation within each time bin would be extremely unreliable (unless several thousands of trials were completed, which in turn would raise the issue of repetition effects; see e.g., Ramon et al., 2011). Moreover, the (multiple) statistical testings per time bin and task for each individual raise the question of an appropriate control for multiple comparisons.

In light of these considerations, here we therefore analysed each observer's SRTs using a Bayesian density estimation with Dirichlet process mixtures. The resulting model represents SRTs as generated from a probability density. For each participant and task, the density function (i.e., the distribution that generates the observed SRTs) is considered as generated from a mixture of latent (true) log-normal distributions as components. The mixture weights are modelled as a Dirichlet process; a standard stick-breaking process was applied to explicitly construct the weight vector. The number of mixture components (K) is truncated at 20, resulting in a truncated Dirichlet process mixture model for the SRT. The full model is parameterized as follows:

Parameters for the mixture components:

$$\mu_i \, \ldots, \mu_K \sim \text{Normal}(0, 10)$$
$$\sigma_1, \ldots, \sigma_K \sim \text{HalfNormal}(2)$$

Stick-breaking process:

$$\alpha \sim \text{Gamma}(1, 1)$$
$$\beta_1, \ldots, \beta_K \sim \text{Beta}(1, \alpha)$$
$$w_i = \beta_i \prod_{j=i-1}^{i} (1 - \beta_j)$$

Mixture density estimation:

$$x \mid w_i, \mu_i, \sigma_i \sim \sum_{i=1}^{K} w_i \text{ logNormal}(\mu_i, \sigma_i)$$

Conceptually, this procedure reconstructs SRTs with appropriate smoothing, and returns a Bayesian uncertainty estimation of SRTs observed at each time point (even in the absence of observations). We estimated the minimum processing time required for each task by comparing the estimation of correct and incorrect SRTs at each time point. A χ^2 test on accuracy within each time bin should, in general, provide similar results to those reported here. However, the approach we opted for has the advantage that the uncertainty of behavioural density functions can be determined per observer and task without requiring arbitrary SRT binning. Additionally, no thresholding for exclusion of anticipatory saccades is required, as these would be naturally captured by one of the mixture components.

Importantly, to take into account the within-observer similarity across SRT distribution density functions, each observer was modelled independently, formulating using the same mixture components and concentration parameter alpha across tasks. In other words, for each participant we fitted the four SRT distributions [2 tasks (familiarity, gender) × 2 types of response (accurate, inaccurate)] in the same model. All four distribution density functions share the same log-normal mixture components with the identical parameters μ and σ, but have different mixture weights w_i. The truncated Dirichlet process mixture model was built using PyMC3 (Version 3.2). We fitted the model using full-rank automatic differentiation variational inference (full-rank ADVI) with multivariate Gaussian approximations. The estimated mixture density function is shown in Figure 2, with the 95% highest posterior density (HPD) interval of the estimation. The SRT density distribution could be captured mostly with 2–3 log-normal densities. Importantly, anticipatory saccades are modelled by the log-normal density peaking around 40 ms.

To quantify the minimum processing time (minSRT), we scaled the mixture density distributions by weighting the density functions with the number of trials observed for each task. Inferences were drawn based on two different approaches. First, we compared the weighted density functions for hits and false alarms to identify the time point at which the 95% HPDs were non-overlapping. Secondly, we compared the differences between the two density functions and zero using the 95% HPD of the contrast. This latter comparison is illustrated in the supplementary material.

Results

Descriptive statistics for individual observers' accuracy scores and SRTs across tasks are reported in Table 1. Figure 3a depicts histograms of the frequency of response per 10-ms SRT time bin (cf. e.g., Rousselet et al., 2003); Figure 3b represents each observer's weighted density function for hits and false alarms (fitted probability distributions are displayed in Supplementary Figures 1, 2 displays the differences between weighted distributions). The observer "Sister" performed at chance for both the gender and familiarity decision task ($z = 0.78$ and $z = 0.36$, respectively, $ps > 0.05$); both posterior comparisons from the model converge and indicate that the sister's density functions for hits and false alarms did

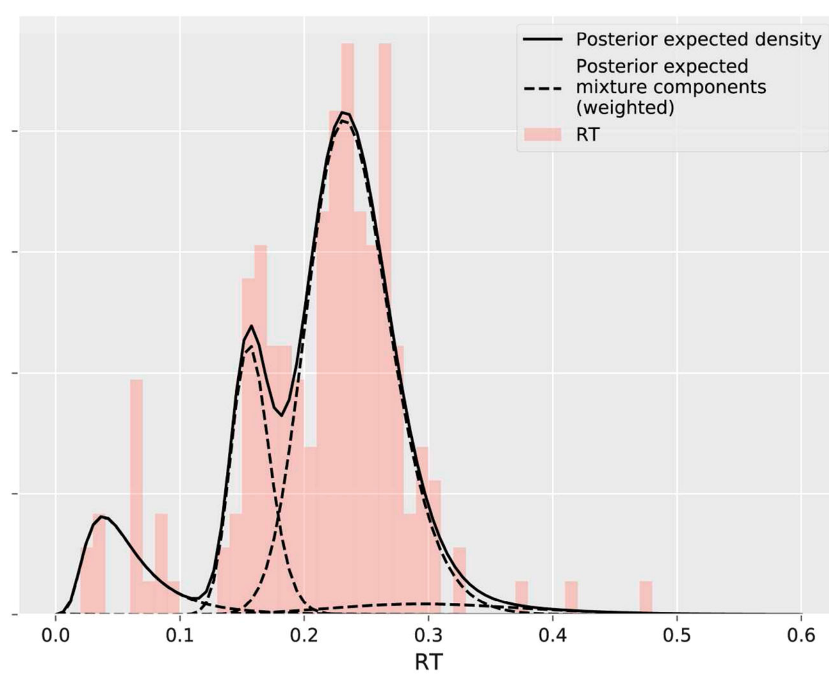

Figure 2. Normalized histogram and fitted distribution for one observer and one condition, which is a weighted mixture of log-normal distribution. RT = reaction time.

Table 1. Accuracy and saccadic reaction times obtained across experiments for each observer. Bold font indicates individual performance accuracy exceeding chance level.

Categorization		Accuracy (%)	Saccadic reaction times (ms) Mean	Median	95% confidence interval
Gender	P.S.	**63**	243	208	[230, 256]
	Sister	52	128	128	[122, 134]
	Daughter	**72**	213	220	[203, 221]
Personal familiarity	P.S.	51	179	186	[172, 188]
	Sister	51	129	127	[123, 135]
	Daughter	**56**	213	226	[202, 222]

not differ across tasks. Performance exhibited by the observer "Daughter" followed a different pattern (see Figure 3b and Supplementary Material). Specifically, for gender decisions, this observer's hits outnumbered false alarms as early as 150 ms. For familiarity decisions, the daughter's SRTs differed from around 175 ms onwards. Analyses of P.S.'s performance for the gender task revealed that hits outnumbered false alarms around 235 ms. For the familiarity task no minSRT could be established.

Discussion

In this study we aimed to determine the extent to which task- and procedure-related constraints govern overt behaviour exhibited by healthy observers and P.S., a rare case of acquired prosopagnosia (Ramon et al., 2017; Rossion et al., 2003). Following our previous work involving personally familiar face processing, we adopted a within-subjects design that focused on performance patterns exhibited by P.S. and two healthy controls across different experimental conditions (Ramon et al., 2017). The observers tested here performed choice saccades towards faces of three family members (familiarity decision), or female faces (gender decision), presented simultaneously with well-matched unfamiliar or male distractor stimuli in the context of a SRT paradigm. Building on our previous findings from healthy observers (Ramon et al., 2017, 2018a), we reasoned that performance and minSRTs would vary with the breadth of operational decisional space. Higher proficiency and faster minSRTs were expected for gender decisions, which require searching for one of two categories. Comparatively lower proficiency and delayed minSRTs were anticipated for familiarity decisions, which required searching one of three predefined target identities.

Mirroring previous findings (Ramon, Sokhn, et al., 2017; Ramon et al., 2018a), one of our two healthy observers—P.S.'s sister—was incapable of performing both gender and familiarity categorizations. Findings from a recent independent study stress that this observer's task-independent poor performance should be attributed to the SRT paradigm, and not an inability to process faces efficiently. In two experiments involving manual gender and familiarity decisions for stimuli presented individually and (para)-centrally without time constraints (Ramon et al., 2018b), this observer performed at ceiling for both tasks and showed a RT advantage for gender decisions. Importantly, her performance pattern mirrored that exhibited by a large group of observers ($n = 78$) tested with an independent set of personally

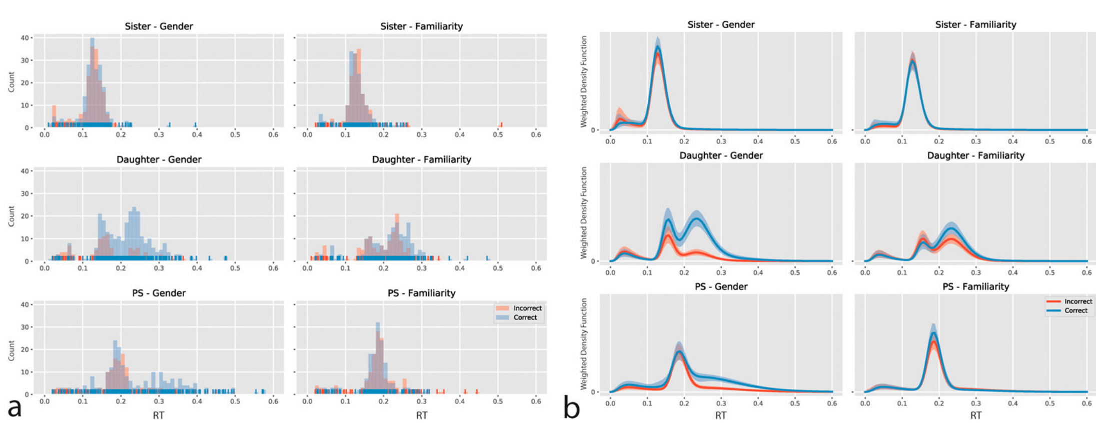

Figure 3. Raw histograms and the weighted density functions after scaling with number of trials. (a) Non-normalized histograms obtained for familiarity and gender decision tasks, for all observers. Frequency of responses is plotted as a function of saccadic reaction times (RTs; 10-ms time bins, cf. e.g., Rousselet et al., 2003). (b) Fitted saccadic reaction time courses for all observers; shaded areas represent the 95% highest posterior density (HPD) of the estimation. RT = reaction time.

familiar faces and identical procedures (Ramon et al., 2018b).

Our second healthy observer—P.S.'s daughter—on the other hand performed above chance across both tasks. Not only was her performance sufficiently high for both binary gender and familiarity decisions; it also varied across tasks as found in other recent studies (cf. Besson et al., 2017; Ramon, Sokhn, et al., 2017; Ramon et al., 2018a; Visconti di Oleggio Castello & Gobbini, 2015). The observed pattern of superior performance accuracy and shorter minSRTs for gender versus familiarity decisions (72 vs. 56%; 150 vs. 175 ms) supports our view that *decisional space*—not the task (Besson et al., 2017), or experience with stimuli per se (Visconti di Oleggio Castello & Gobbini, 2015)—determines visual categorization performance.

The present findings add to an increasing body of studies reporting inter-individual differences in healthy observers' visual categorization performance in the context of SRT paradigms (Mathey et al., 2012; Ramon, Sokhn, et al., 2017; Ramon et al., 2018a; Visconti di Oleggio Castello & Gobbini, 2015), which to our knowledge has not been systematically investigated. Further studies are required to establish the implications of the observed variability in observers' ability in performing tasks in temporally sensitive SRT paradigms. Based on our observations, we suggest that SRT paradigm usage should involve deploying different experiments with varied tasks/procedures in order to establish a *pattern* of performance per observer. This approach allows us to distinguish between a generic inability to perform speeded categorizations (cf. P.S.'s sister), and one that is confined to the specific procedural conditions of a single experiment (cf. P.S.).

Most interestingly, and in line with our expectations, P.S. was capable of performing binary gender, but not familiarity decisions. Importantly, closer investigation of P.S.'s performance revealed that not only was she comparatively less accurate (63%), but also that the *distribution* of her SRTs differed fundamentally from that of her daughter, leading to comparatively prolonged minSRTs (235 ms). This highlights the importance of considering task-related decisional space constraints and how they impact performance of both healthy and brain-damaged patients (Ramon, 2018). Moreover, it demonstrates that subprocesses of face cognition cannot be considered as independent based solely on performance dissociations, which may arise due to differences in the operational decisional space.

Previous studies have successfully employed SRT paradigms to characterize differences in processing speed during different types of visual categorizations. Observers exhibit high performance and rapid SRTs when distinguishing between *different categories*—for example, during animal or face detection (Crouzet, Kirchner, & Thorpe, 2010; Kirchner & Thorpe, 2006). Our findings suggest that when using face stimuli only—that is, the *same visual category*—decisional space constraints require careful consideration. While normal observers perform gender decisions in a highly accurate manner (Ramon et al., 2017, 2018a) familiarity decisions are challenging for several healthy observers (Ramon, Sokhn, et al., 2017; Ramon et al., 2018a; Visconti di Oleggio Castello & Gobbini, 2015). This suggests that familiarity decisions performed in the context of SRT paradigms are not a reliable measure of observers' ability to discriminate between familiar and unfamiliar faces. P.S.'s, as well as her sister's, chance-level performance observed here should therefore not be misinterpreted as an absolute inability to ascertain face familiarity in real-life scenarios, where facial information is available centrally and for longer time periods (see also Ramon et al., 2017; Ramon et al., 2018b). Additionally, the precise contribution of facial information used for gender and familiarity decisions cannot be delineated given the nature of the paradigm employed here. Response classification studies controlling for information available are required to address this question (for personally familiar face identification in P.S. using Bubbles, Caldara et al., 2005; Gosselin & Schyns, 2001, see Ramon, Sokhn, et al., 2017). Finally, further studies are required to determine whether similar decisional space constraints can be found for other visual categories, or whether exemplar-level processing is a prerequisite. Indeed, assessing task- and procedure-dependent changes in individuals' performance across different stimulus categories may represent a novel way to determine the specificity of visual processing deficits.

Altogether, our findings emphasize that task demands and procedural aspects determine the decisional space within which visual categorizations are performed. Specifically, observers' expectations related to stimulus probability can profoundly affect their overt performance. Importantly, this holds for both healthy *and* brain-damaged patients alike. These findings have important implications for behavioural assessment in general (Ramon, 2018), and should be exploited to broaden our understanding of healthy and impaired cognitive functioning.

Note

1. Note that the procedural parameters used in both experiments paralleled those used by Visconti di Oleggio Castello & Gobbini (2015), with exception of stimulus presentation duration (600 ms instead of 400 ms), as initial pilot testing revealed that slightly longer presentation durations were necessary for acceptable performance levels (Ramon, Sokhn, et al., 2017; Ramon et al., 2018a).

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Disclosure statement

No potential conflict of interest was reported by the authors.

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