Exploration des liens entre les compétences cognitives, émotionnelles et sociales chez des adultes avec syndrome de Down

Hippolyte, Loyse

EXPLORATION DES LIENS ENTRE LES COMPÉTENCES COGNITIVES, ÉMOTIONNELLES ET SOCIALES CHEZ DES ADULTES AVEC SYNDROME DE DOWN

Loyse HIPPOLYTE

Candidate au titre de Docteure en Psychologie

Jury composé des Professeurs :

Koviljka Barisnikov, co-directrice, Université de Genève

Martial Van der Linden, co-directeur, Université de Genève

Yannick Courbois, Université de Lilles 3

Jean-Jacques Detraux, Université de Liège

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Préambule

Le syndrome de Down (SD) est une maladie génétique relativement fréquente (une naissance vivante sur 600 à 800 selon les études) et qui demeure l'une des causes les plus courantes de déficience intellectuelle d'origine génétique. Les personnes avec SD sont souvent considérées comme chaleureuses, attachantes et sensibles. Cette image positive a été renforcée dans le grand public par l'intermédiaire de films et séries télévisées mettant en scène des acteurs porteurs d'un SD (« Le huitième jour » de Jaco van Dormael, « Corky un enfant pas comme les autres »), mais elle est également présente dans la littérature scientifique, où plusieurs études soulignent le caractère communicatif et plaisant des enfants avec SD. Ces dernières années, les travaux ont cependant relevé chez ces personnes certaines difficultés affectant le comportement socio-émotionnel telles que des conduites d'opposition, un comportement envahissant ou encore un retrait social.

Les compétences impliquées dans la mise en place d'un fonctionnement socio-émotionnel adéquat telles que la reconnaissance des émotions, l'attribution d'une émotion en fonction d'un contexte ou encore les capacités à se mettre à la place d'autrui ont fait l'objet de plusieurs études chez les enfants avec SD. Ces recherches ont mis en évidence des difficultés plus importantes que celles attendues en fonction de l'âge développemental des enfants examinés. Toutefois, l'origine de ces difficultés et leur impact spécifique sur le comportement socio-émotionnel dans la vie quotidienne sont encore mal compris. En outre, les processus de traitement de l'information émotionnelle et sociale ont été très peu étudiés chez les adultes avec SD.

Dans ce travail de thèse, notre objectif a été précisément d'explorer certaines compétences socio-émotionnelles auprès d'adultes avec SD, en proposant des épreuves adaptées à leur niveau de déficience intellectuelle. Nous avons ainsi examiné chez ces personnes la reconnaissance d'expressions émotionnelles faciales sous différentes modalités (identification, appariement, discrimination), l'attribution d'une émotion faciale en fonction d'un contexte et les capacités de raisonnement social. Les performances des adultes avec SD ont été comparées à celles d'enfants au développement normal, appariés sur une mesure du langage réceptif. Nous nous sommes également intéressées aux liens entre ces compétences socio-émotionnelles spécifiques et certaines capacités cognitives générales telles que le raisonnement non verbal, le langage, l'inhibition et l'attention sélective. Enfin, nous avons

exploré les relations entre les capacités de raisonnement social et le comportement socio-émotionnel dans la vie quotidienne.

II. Partie Expérimentale

Problématique

Notre travail de thèse avait pour objectif principal d'explorer les capacités de traitement des informations émotionnelles et sociales chez les personnes adultes avec SD. Comme il a été montré dans l'introduction théorique de ce travail, il existe à l'heure actuelle très peu d'études portant sur ces problématiques dans la population avec SD. Dans cette perspective, nous avons investigué deux domaines en particulier : les capacités de reconnaissance des expressions faciales et d'attribution d'une émotion en fonction d'un contexte d'une part et les capacités de raisonnement social d'autre part. Par ailleurs, nous nous sommes intéressées aux relations entre ces compétences socio-cognitives spécifiques et des capacités cognitives générales qui seraient plus particulièrement impliquées dans la résolution de ces épreuves (études 1, 2 et 4). Les liens avec le profil du comportement socio-émotionnel et les capacités de raisonnement social ont également été investigués (étude 4).

Les études 1, 2 et 3 ont été consacrées aux processus de traitement des expressions émotionnelles. Dans l'étude 1, la reconnaissance des expressions faciales a été évaluée sous trois modalités : identification, appariement et reconnaissance des expressions. L'étude 2 était constituée de deux parties ; la première a proposé une réplique du design expérimental de l'étude 1, où des modifications ont été introduites dans les tâches d'identification et d'appariement des expressions (addition d'items, de distracteurs, et de l'expression faciale neutre). La deuxième partie s'est intéressée aux capacités d'attribution d'une expression émotionnelle en fonction d'un contexte. Les relations entre ces compétences d'attribution et le traitement des émotions évalué dans l'expérience 1 ont été investiguées. L'étude 3 s'est penchée sur les capacités d'inhibition d'une réponse dominante selon que son contenu introduise une composante émotionnelle (expression faciale de joie ou de tristesse) ou une composante neutre (image d'une lune ou d'un soleil). Enfin, l'étude 4 a porté sur le domaine relatif au traitement des informations sociales. Nous avons examiné les compétences de raisonnement social au moyen d'une tâche expérimentale.

ETUDE 1

Face Processing and Facial Emotion Recognition in Adults with Down Syndrome[30, 31]

Abstract

Face processing and facial expression recognition was investigated in 17 adults with Down syndrome, and results were compared with those of a child control group matched for receptive vocabulary. On the tasks involving faces without emotional content, the adults with Down syndrome performed worse than did the controls. However, their performance was good on the tests with complete faces. On the facial expression tasks, participants with Down syndrome exhibited particular difficulties with the neutral and surprised expressions. Analysis of their error pattern suggests they had a tendency to judge faces more positively than did the controls. Finally, there were significant relationships among emotional processing, receptive vocabulary, and inhibition measures; nonverbal reasoning ability was not related to any of the tasks.

[30] This study is a reprint of the article: Hippolyte, L., Barisnikov, K., & Van der Linden, M. (2008). Face processing and facial emotion recognition in adults with Down syndrome. *American Journal on Mental Retardation, 11*, 292-306.

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1 Introduction

Identifying faces and recognizing facial emotional expressions are important skills for successful social interactions. Research conducted on emotional understanding in a population with mental retardation has highlighted particular deficits when compared with control participants matched for chronological age (CA) and mental age (MA) (Maurer & Newbrough, 1987a; Rojahn, Rabold, & Schneider, 1995). More recently researchers have investigated these competencies, taking into account the etiology of the mental retardation, and have focused on populations with autism or genetic disorders, such as Williams syndrome, fragile X syndrome, or Turner syndrome (Karmiloff-Smith et al., 2004; Lawrence, Kuntsi, Coleman, Campbell, & Skuse, 2003; Matheson & Jahoda, 2005; Robel et al., 2004; Rondan, Gepner, & Deruelle, 2003). Surprisingly, only a few researchers have investigated emotion processing in people with Down syndrome, and to the best of our knowledge, no research has been specifically conducted on face processing. In addition, previous research has been focused mainly on child populations.

In a series of three experiments, Kasari, Freeman, and Hughes (2001) examined the comprehension of four basic emotions (happiness, sadness, anger, and fear) in children with Down syndrome through administration of three tasks, including labeling, recognizing, and identifying facial emotions within a familiar context (e.g., being taken to the zoo by mother, being alone in the dark). They used a puppet made of felt that had an expressionless face. Four felt faces (representing the four emotions) completed the material. In the first experiment, the results of the Down syndrome group (CA = 6.5 years, MA = 3.6) were compared with those of typically developing children matched for CA and MA (mean IQ was measured using the Stanford-Binet Intelligence Scale [Thorndike et al., 1986]). Kasari et al. did not find differences between the Down syndrome and MA groups on any of the three tasks, with both groups performing significantly worse than the CA group. In addition, the Down syndrome and MA groups showed a specific pattern of errors compared to the CA group, tending to mistake a negative emotion for a positive one.

In the second experiment, Kasari et al. (2001) matched children with Down syndrome (CA = 8 years, MA = 4) on MA to typically developing children and children with mental retardation of unknown etiology (MA = 4). They did not observe any differences between groups in the emotion recognition task, but the children with Down syndrome were less accurate than those in the MA group in verbally labeling the negative emotions (anger and fear) and less accurate than both control groups in identifying these two emotions from a

context-based story. As in the first experiment, children with Down syndrome showed a tendency to misidentify negative emotions as positive ones, but this tendency was not observed in the two control groups.

In the third experiment, Kasari et al. (2001) followed 16 children with Down syndrome who had participated in Experiments 1 and 2, tracking their progress over a 2-year period. The same three tasks were examined, but not the error pattern. The results indicated a significant improvement in the labeling task only. The authors proposed that children with Down syndrome have difficulty dealing with these emotional tasks due to a lack of exposure to varied emotional stimuli. Their interpretation was based on a study by Tingley, Gleason, and Hooshyar (1994), who reported that mothers of preschool children with Down syndrome used fewer words referring to feelings and cognitive states and a less elaborate emotional repertoire than did mothers of typically developing children. Kasari et al. suggested that the results might also be related to the particular personality (friendly, sociable, well disposed) that Down syndrome children tend to have. Negative expressions might be used less frequently by their families because of their pleasant dispositions. Thus, these personality traits might interfere with the acquisition of knowledge of negative expressions, which may explain the specific impairment affecting the recognition of anger and fear. In case of hesitation, children would have a specific set of responses (i.e., happy).

Kasari et al.'s (2001) interesting study has some methodological weaknesses. The lack of a control task raises doubts about whether children with Down syndrome have a specific impairment in processing emotional stimuli. In fact, they might have difficulties processing faces in general, which could hinder them in reacting to emotional facial stimuli. Moreover, the experimental tasks presented by Kasari et al. had very few items: one item per emotion for labeling and recognition tasks and two for the identification task.

Turk and Cornish (1998) conducted a study using the same four emotions employed by Kasari et al. (2001) (happiness, sadness, anger, and fear). Participants were children with fragile X syndrome (CA = 10 years, MA = 6). The British Picture Vocabulary Scale (L. Dunn et al., 1982) was administered as a matching measure. Results of the children with fragile X syndrome were compared with those of MA-matched typically developing children and children with Down syndrome (CA = 10 years). Emotion recognition was studied under three conditions: facial expression (schematic drawings of faces showing the four emotions), vocalized emotions, and recognition of emotions in different social contexts (e.g., getting ice cream, being chased by a dog). Contrary to the Kasari et al. (2001) study, Turk and Cornish did not find differences among groups in the first two conditions, in which children had to

identify the emotions. On the other hand, the children with Down syndrome obtained lower results than did those in the other two groups when matching expressions according to a social context. Turk and Cornish proposed that the poor performance of the children with Down syndrome on this task might be related to a reduction in working memory resources, although they did not elaborate on this hypothesis. Again, the small number of items used by these researchers (four items per task) considerably limited the interpretation of the results.

Recognition of emotional expressions (happiness, surprise, sadness, fear, anger, and disgust) by children with Down syndrome was also examined by Wishart and Pitcairn (2000) in two experiments. Stimuli were photographs taken from Ekman and Friesen's (1976) Facial Affect Slides. The authors compared the performance of children with Down syndrome 8 to 14 years of age with that of typically developing children (CA range = 3 to 5) and children with nonspecific mental retardation (CA range = 8 to 14) on the basis of performance on the Kaufman Facial Recognition subtest (Kaufman & Kaufman, 1983). These investigators administered three experimental tasks in the first experiment: matching faces according to identity, matching faces according to emotional expression, and matching facial emotions to a brief verbal story (e.g., receiving a present). The Down syndrome group scored lower on all tasks than did children in both control groups, but they differed significantly only in the emotion matching task and specifically for expressions of surprise and fear. In the second experiment, participants had to match emotions (happiness and anger) and faces according to identity under rotation (0°, 90°, 180°). Results for the Down syndrome group were significantly lower than those of the MA group on the emotion matching task. On the identity task, their performance was significantly poorer than that of either control group. Based on results of these two experiments, Wishart and Pitcairn suggested that children with Down syndrome had a global impairment in processing emotional expression, but these conclusions may be questionable due to the small number of items (only one per emotion) used in these experiments.

In a more recent study, Williams, Wishart, Pitcairn, and Willis (2005) administered the same identity and emotion matching tasks used previously by Wishart and Pitcairn (2000) to children with Down syndrome 7 to 17 years of age (MA range = 3 to 6 years), typically developing children (CA range = 3 to 6 years), and children with nonspecific intellectual disabilities (CA range = 6 to 17 years). The groups were matched on the basis of scores on the Wechsler Preschool and Primary Scales of Intelligence—WPPSI-R (Wechsler, 1990) or Wechsler Intelligence Scale for Children—WISC-III (Wechsler, 1992) and the Benton Facial Recognition Test short-form (Benton et al., 1983). Williams et al. assessed the same six

emotions (happiness, surprise, sadness, fear, anger, and disgust) but increased the number of trials (18 trials for the identity task, 3 trials per emotion in the emotion task). On the identity matching task, results for the Down syndrome group were significantly poorer than those of both control groups. The authors explained these results by suggesting a decreased task engagement rather than impaired performance, given that the children with Down syndrome were able to process the first part of the task as well as the two control groups did. On the emotion matching task, the Down syndrome children obtained poorer overall performance compared with the typically developing children, but the difference was only relevant for the emotion of fear. The relationship between the emotion task and specific abilities (language, adaptive behavior) was also explored, as was the pattern of error in the emotion task. With regard to the Down syndrome error pattern, Williams et al. did not observe the confusion between positive and negative emotions found by Kasari et al. (2001). Indeed, the errors did not show any specific trend. Finally, no significant correlations appeared between performance on the experimental tasks and specific abilities or CA.

In the studies discussed above, researchers examined several emotional expressions under different conditions, and most of them found impairments in emotion recognition in children with Down syndrome. Negative expressions such as anger and fear seemed to be harder to recognize, although the results varied among studies. Kasari et al. (2001) found a tendency to mistake a negative emotion for a positive one; this error pattern was not confirmed by Williams et al. (2005). The large variety of stimuli (photographs, schematic drawings, vocalization) and task conditions (identification, labeling, emotion-to-story matching) as well as the limited number of items used by most of the researchers restricted the generalization of their results. Moreover, as emphasized by Williams et al., some of the emotional tasks administered might have made additional cognitive demands on verbal memory and expressive language, which tend to be weak in individuals with Down syndrome (Brock & Jarrold, 2005; Jarrold & Baddeley, 2001). Thus, the deficits observed might not be related to emotional impairments but, rather, be due to the difficulty of the task. Nevertheless, the studies done with Down syndrome children have shown that CA and developmental age do not seem to be related to a better understanding of emotions in this population. However, we do not have information about emotional recognition abilities in adults with Down syndrome as, to our knowledge, no studies have yet been published. One study of children with Down syndrome (Williams et al., 2005) included adolescents up to 17 years of age, and the results showed that they did not outperform their younger peers. This finding suggests that adults with Down syndrome probably do not process emotional stimuli better than do

children. This hypothesis is supported by results found in Tingley et al.'s (1994) study, which indicated that children with Down syndrome grow up in environments with poorer exposure to emotions, hindering the development of their emotional skills. In addition, some authors have reported that personality influences (Kasari et al., 2001) and the deleterious effect of social stigmas and withdrawal often observed in people with mental retardation (D. G. Moore, 2001) might also have a negative influence on the acquisition of emotional knowledge. Moore stated that children with mental retardation might have preserved basic emotion recognition skills and that it is their particular subsequent development that will lead them to have impairment in adulthood. Despite the above observations, it may be possible for individuals with Down syndrome to develop social and emotional abilities in adulthood. In the last 3 decades, a major effort has been made to improve the quality of the social environment for people with mental retardation (e.g., workshops, cinemas, sports, holiday camps). These social stimulations could have a positive impact on the development of their emotional abilities. Therefore, it is of great interest to explore emotional processing in adults with Down syndrome, particularly how facial emotion recognition abilities manifest in adulthood. Social and behavioral difficulties, which are often reported by caregivers and families, may be related to specific emotional deficits (Clark & Wilson, 2003; Dykens et al., 2002). Investigating these competences is also important with a view to developing rehabilitation strategies in the future.

Thus, our aim in the present study was to investigate different aspects of emotion recognition and face processing in adults with Down syndrome. We presented tasks assessing facial stimuli with and without emotional content. This experimental design allowed us to clarify whether an impaired performance was specific to emotional stimuli or was related to face processing (Moore, 2001). Facial processing abilities were evaluated by an Identity Matching subtest showing faces with a neutral expression, which withdrew emotion processing demands. The capacity to process facially expressed emotions was examined through different modalities (identification, matching, and recognition) (Bruce et al., 2000; Rojahn, Rabold et al., 1995). To avoid additional information processing loads, we designed the experimental tasks to make minimal demands on verbal memory and expressive language. In all tasks, the stimuli were limited to facial information (no hairline or clothing) to avoid the influence of nonfacial features (Duchaine & Weidenfeld, 2003). Specific cognitive tasks assessing nonverbal reasoning and inhibition were given to the Down syndrome group in order to explore their relationship with facial emotional processing. Thus, some authors have claimed that emotion recognition is related to more general cognitive abilities in adults with

mental retardation (D. G. Moore, 2001; Simon, Rosen, & Ponpipom, 1996), whereas others have asserted that there is a specific deficit (Rojahn, Rabold, & Schneider, 1995). The potential influence of inhibition processes, which are often reported to be impaired in Down syndrome people (Rowe et al., 2006), was controlled for. These competencies seem to be related to tasks involving emotional and social processing (Carlson & Moses, 2001; Grant, Apperly, & Oliver, 2007). The results of the adults with Down syndrome were compared with those of typical developing children matched on a receptive vocabulary task. We chose this match to check for differences in verbal ability that might interfere with the emotional tasks (Bieberich & Morgan, 2004; Turk & Cornish, 1998). This approach allowed us to identify whether the performance of adults with Down syndrome was impaired in terms of a quantitative score difference (e.g., presence of developmental delay). Moreover, if qualitative differences were observed between the groups, it would allow us to define the pattern of performance of the Down syndrome group (e.g., atypical processing).

2 Method

2.1 Participants

The participants were 17 adults with Down syndrome (8 men, 9 women) with moderate mental retardation who were recruited from two sheltered workshops. All of them had a medical diagnosis of Trisomy 21 and had attended special schools for people with mental retardation. Sensory, psychiatric, or physical disabilities and clinical symptoms of dementia were exclusion criteria for participation. The mean age of this group was 33.3 years (*SD* = 10.5). The control group consisted of 17 typically developing children (8 boys, 9 girls) who attended an elementary public school (mean age = 5.9 years, *SD* = 0.7). The two groups were matched on a receptive vocabulary task, as reflected by the raw score on the French adaptation (L. Dunn, Thériault-Whalen, & Dunn, 1993) of the Peabody Picture Vocabulary Test-Rev. (L. Dunn & Dunn, 1981)—hereafter referred to as the PPVT-R-F. On this task, the Down syndrome group obtained a mean raw score of 70.41 (*SD* = 15.11) and the control group had a mean score of 70.23 (*SD* = 16.52). These scores corresponded to a developmental verbal age of 6.08 years (for the Down syndrome group: *SD* = 1.29, range = 4.58 to 9; for the control group: *SD* = 1.17, range = 4.5 to 8.08). This difference was not statistically significant.

We administered additional cognitive tasks to the adults in the Down syndrome group to check for their potential influence on the experimental tasks. Nonverbal reasoning ability

was assessed using Raven's Coloured Progressive Matrices (Raven et al., 1998), mean raw score = 20.17, *SD* = 4.15 (corresponding approximately to an IQ of 67). Inhibition measures were assessed by the day–night Stroop-like task (Gerstadt, Hong, & Diamond, 1994) and the tapping task (Diamond & Taylor, 1996). Both tasks require participants to remember two rules and to inhibit a strong response tendency (a verbal response for the day–night, a motor response for the tapping task). The adults with Down syndrome obtained a mean score (percentage) of 82.35 (*SD* = 30.79) in the day–night task and a mean score (percentage) of 64 (*SD* = 29.21) in the tapping task. Compared to norms established with typically developing children (Diamond & Taylor, 1996), the performance of the adults with Down syndrome was equivalent to an MA of 5.9 for the day–night task and 3.7 for the tapping task.

2.2 Materials and Procedure

In the present study we used tests taken from the Face Processing Tests (Bruce et al., 2000) to assess facial emotion identification and matching as well as face processing with the Identity Matching Test. The Facial Discrimination Task (Rojahn, Rabold, & Schneider, 1995) is used to assess facial emotion recognition and emotion intensity attribution. Participants were tested individually and three to five sessions (15 to 25 min each) were necessary to administer the various tasks, depending on the participant's fatigue and cooperativeness. An assessment adapted to the participant's pace and attention level was critical to prevent lack of motivation, which can be observed in this population. The various sessions took place over approximately 1 to 2 weeks, in accordance with the participants' availability and work schedule. The cognitive tasks were administered first, followed by the Face Processing Tests and Facial Discrimination Task. Assessments were conducted in a quiet room at the sheltered workshop for the Down syndrome group; the typically developing children were assessed in a room at their school.

Face Processing Tests

All stimuli used in the Face Processing Tests are images of children's and adults' faces (monochrome photographs, 5.5 cm × 4 cm) presented with a uniform grey background in order to exclude visible paraphernalia.

Identity matching. Five subtests are given using the same design: A child target face is shown at the top of the page and participants have to identify the target face (out of two faces) at the bottom of the page. Each subtest includes 16 items. The first two subtests, Face-Dis and

Face-Sim, vary regarding the dissimilarity/similarity, respectively, of their distracters (same vs. different gender, age, and general appearance, like hair color or shape of the face). The following two subtests, Masked-Dis and Masked-Sim, present faces that are dissimilar/similar (same criterion), respectively, with the hair and ears concealed. The fifth subtest, Eyesmasked-Sim, presents similar faces with hair, ears, and eyes concealed. One trial item is offered for the first three subtests to ensure that participants understand. Rough difficulty levels established by Bruce et al. (2000) for the Identity Matching Test show that success rates for the last two subtests (Masked-Sim and Eyesmasked-Sim) are not above the chance level before the age of 7 or 8. Nevertheless, all subtests were presented in this study because we had no specific hypothesis concerning the participants with Down syndrome.

Emotion identification. In the Emotion Identification Test, participants are shown pairs of children's faces and have to point to the face in each pair that displays a particular emotion named orally by the experimenter. The emotions of happiness, sadness, anger, and surprise are assessed (3 items per emotion).

Emotion matching. In the two Emotion Match Tests, a target face is shown at the top of the page and the participants are asked to point to the face at the bottom (out of two) that displays the same expression as the top one. Two tests showing children's and adult's faces (12 items, respectively) are presented with the same expressions as in the Emotion-Identification Test (3 items per emotion). One trial item is administered in the first test.

Facial Discrimination Task

Emotion recognition and intensity attribution. In this task, 41 black and white photographs of faces (13 cm × 18.5 cm) with three different expressions (happy, sad, or neutral) are presented. The participants have to indicate whether a given item depicts a happy face, a sad face, or a face that is neither happy nor sad (neutral). If the response is happy (or sad), the participants are then asked to decide between two intensity levels for this emotion. Level 1 is for a face that is *a little* happy or sad and Level 2, for a face that is *a lot* happy or sad. Responses are given by pointing to a visual aid represented by short (Level 1) and long (Level 2) vertical columns. Participants have a training session with 6 items before performing a test with 35 items representing 12 happy faces (9 for the first level, 3 for the second), 12 neutral faces, and 11 sad faces (7 for the first level, 4 for the second) presented in a random order.

3 Results

3.1 Face Processing Tests

The assumption of normality of distribution using one-sample Kolmogorov-Smirnov tests was examined for all Face Processing Tests variables (separately for each group). Normality was found for the Identity Matching Test, allowing us to conduct parametric analyses. The two emotion tests (Emotion-Identification and Emotion-Match) did not follow a normal law, as some scores were close to ceiling. Therefore, we used a nonparametric approach for these two tests. Main descriptive data are summarized in Table 1.

Table 1. Mean raw scores by group on the Face Processing Tests (FPT) Identity and Emotion subtests and the Facial Discrimination Task (FDT) Scores.

		Down syndrome		Controls	
Measure	Maximum score	Mean	*SD*	Mean	*SD*
Face Processing Tests					
Identity matching					
Face-Dis	16	15.17	1.38	15.88	.33
Face-Sim	16	13.76	2.61	15.11	.69
Maskedface-Dis	16	8.17	2.72	10.29	2.64
Maskedface-Sim	16	7.58	2.39	8.58	2.57
Eyesmasked-Sim	16	7.35	2.59	7.47	2.74
Emotion identification					
Happiness	3	2.94	0.24	3.00	0.00
Sadness	3	2.58	0.50	2.88	0.33
Anger	3	2.76	0.56	2.94	0.24
Surprise	3	2.17	0.88	2.88	0.33
Emotion matching					
Child’s face	12	8.23	1.56	10.70	1.26
Adult’s face	12	7.88	1.83	10.64	1.41
Facial Discrimination Task					
Emotion recognition					
Happiness	12	10.94	0.55	11.11	0.48
Sadness	11	9.29	1.53	9.23	1.43
Neutral	12	7.35	4.58	11.11	0.78

Face Processing Tests

Identity Matching Test. We first analyzed the Identity Matching Test data using a 2 (group) × 3 (test) repeated-measure ANOVA. The last two subtests (Masked-Sim, Eyesmasked-Sim) were not included in the analysis because results from both groups were close to chance level (score near 8). Figure 1 illustrates percentage scores (per group) for the five subtests. Significant main effects of group, $F(1, 32) = 8.63$, $p = .006$, and test, $F(2, 64) = 125.66$, $p < .0001$, were observed, but the interaction between test and group was not significant, $F(2, 64) = 1.22$, $p = .25$. We then investigated main effects of group and test, using Bonferroni post-hoc comparisons. These analyses were done in order to determine whether the difficulty levels established by Bruce et al. (2000) could also be found in this study. No significant differences appeared between the groups on the three subtests (Face-Dis, Face-Sim, Masked-Dis), but we note that the Down syndrome group performance on the Masked-Dis subtest was close to chance level. Both groups performed better on the first subtest, Face-Dis, followed by the Face-Sim and Masked-Dis subtests, which corresponded to the results in Bruce et al.'s developmental study. Finally, between-group comparison analyses (Student *t* tests) were used in the last two subtests, Maskedface-Sim and Eyesmasked-Sim, where no significant differences appeared.

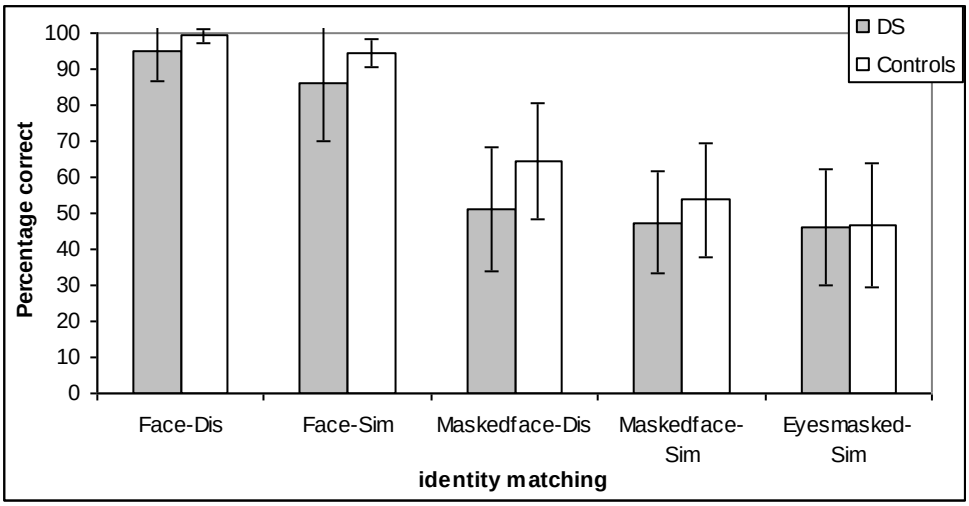

Figure 1. Face Processing Tests Identity matching scores (%) in Down syndrome compared with control group.

Emotion tests. Figure 2 shows percentage scores (per group) for both emotion tests. For the Emotion Identification Test, we analyzed emotions separately, using Mann-Whitney *U* tests. There was a significant group difference for the emotion of surprise, $U = 73.5$, $p =$

.004, which was better identified by the control group. On the Emotion Matching Tests, adults with Down syndrome scored significantly lower than did the control group on tests representing both children's faces, $U = 28$, $p < .0001$, and adults' faces, $U = 35$, $p < .0001$. Finally, no differences were observed within groups on these two tests.

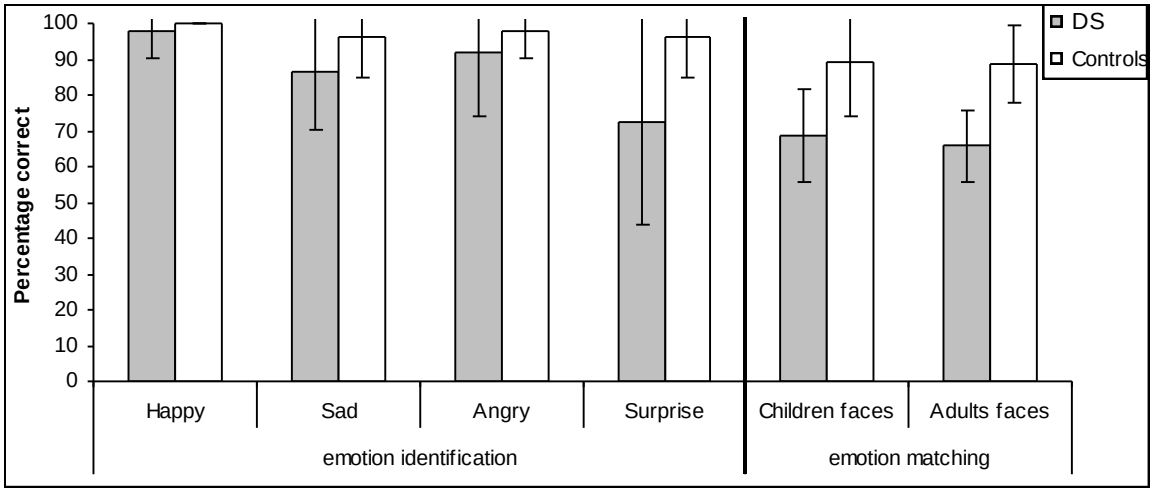

Figure 2. Scores (%) for the Face Processing Tests Emotion identification and Emotion matching tests for Down syndrome and control groups.

Correlations Among Face Processing Tests, Cognitive Tasks, and CA

We employed Kendall's Tau-b nonparametric correlations to investigate the relationships among various Face Processing Tests, the cognitive measures, and CA for the Down syndrome group. Main correlations are presented in Table 2 for both groups. For face processing abilities (5 Identity Matching subtests), we did not observe any significant relationship between these subtests and cognitive measures or CA in the Down syndrome group. No relationship was found in the control group either.

Correlations among the emotion tests, the cognitive measures, and CA were then investigated. Significant positive relations were found in the Down syndrome group between receptive vocabulary score (PPVT-R-F) and identification of angry expressions, $\tau = .47$, $p = .024$, and surprise, $\tau = .46$, $p = .022$. A positive relation was also observed between the PPVT-R-F and the Emotion Matching Test (adults' faces), $\tau = .41$, $p = .033$. No significant correlations were found for the control group. Finally, in order to investigate the relations between face processing and facial emotion processing, we conducted correlations between the Face Processing Tests as a whole. However, the correlations were not significant in either group.

Table 2. Correlations between Face Processing Tests (FPT) main scores and Facial iscrimination Task (FDT) main score, chronological age (CA), and cognitive measures by group

	FPT Tasks (Tau-B)							FDT Task (Pearson)			
	Identity matching	Emotion identification[a]				Emotion matching		Emotion recognition			
Group/ Variable	Total score	H	Sa	A	Su	child	adult	H	N[b]	Sa	Bias
Down syndrome											
CA	-.20	-.08	-.06	-.36	-.31	-.25	-.03	.01	-.12	.11	.27
PPVT-R-F	.16	.21	-.08	.47*	.46*	.08	.40*	-.68*	.68*	.04	-.43
Raven	-.06	-.13	.21	-.05	-.02	-.21	-.01	-.34	.34	-.43	-.01
Inhibition											
Day-night	.09	.24	.24	.29	.16	-.09	.37	-.16	.14	.08	-.77**
Tapping	.23	-.15	-.09	.26	.39	.18	.13	.05	.43	-.12	-.03
Control											
CA	.26	—	.42	-.15	-.37	.00	.15	.28	.04	.44	-.20
PPVT-R-F	.31	—	.09	.08	.00	.33	.03	.25	.12	.39	-.21

[a]H = happiness, SA = sadness, A = anger, Su = Surprise. [b]Neutral.

*p < .05. **p < .01.

3.2 Facial Discrimination Task

We performed statistical parametric analyses for the Facial Discrimination Task because all variables followed a normal law, except the score for the happy expression, for which the data were close to ceiling effect. However, nonparametric analyses of the data produced fundamentally the same results. We first conducted a 2 (group) × 3 (expression) repeated-measure ANOVA to investigate whether the two groups differed significantly on the recognition of happy, sad, and neutral expressions (scores in percentages). Figure 3 provides scores for each group for these expressions (Table 1 shows main raw scores). The analysis revealed main effects of group, $F(1, 32) = 11.51$, $p = .002$, and expression, $F(2, 64) = 5.38$, $p = .006$. A significant interaction between expression and group, $F(2, 64) = 7.83$, $p = .001$, was also observed. Bonferroni post-hoc comparisons revealed that the adults with Down syndrome recognized significantly fewer neutral faces than did their controls, $p < .0001$. The Down syndrome group identified both sad, $p = .009$, and happy, $p < .0001$, expressions more easily

than the neutral ones; no significant differences were found among the three expressions for the control group.

Figure 3. Emotion recognition in Down syndrome group compared with control group for the Facial Discrimination Task (%).

A 2 (group) × 4 (intensity) repeated-measure ANOVA was then performed to determine whether groups differed significantly when rating emotion intensity (Happy 1, Happy 2, Sad 1, and Sad 2). The ANOVA revealed significant main effects of group, $F(1, 32) = 14.71$, $p < .0001$, and intensity, $F(3, 96) = 23.89$, $p < .0001$, as well as a significant interaction effect, $F(3, 96) = 2.64$, $p = .05$. Subsequent Bonferroni post-hoc comparisons showed that the adults with Down syndrome differed from the controls only on the recognition of very sad faces, where they identified significantly fewer items, $p < .0001$. We observed that the Down syndrome group identified the very happy faces significantly better than all the other expressions, whereas no significant difference appeared for recognition of other expressions (Happy 1, Sad 1, and Sad 2). On the other hand, the control group obtained high results for both very happy and very sad faces, which were significantly better identified than the low emotion intensities.

In order to investigate the results obtained on the Facial Discrimination Task more precisely, we analyzed all responses for the two groups. Table 3 presents the percentages of responses (correct and incorrect) for each emotion according to intensity. In general, we observed that the participants rarely selected an emotion in the opposite hedonic tone (e.g., happy for sad) when they gave an incorrect answer.

Table 3. Facial expressions given by groups for photographs in Facial Discrimination Task (%)

	Expected answers									
	Happy 1		Happy 2		Sad 1		Sad 2		Neutral	
Responses[a]	DS	Child[b]	DS	Child	DS	Child	DS	Child	DS	Child
Happy 1	**29**	**33**	14	4	4	3	1	0	15	3
Happy 2	59	58	**86**	**94**	0	2	1	0	7	1
Sad 1	3	0	0	0	**51**	**52**	49	6	14	4
Sad 2	0	0	0	2	27	26	**47**	**91**	2	1
Neutral	9	9	0	0	18	19	1	3	**61**	**93**

Note. Bolface type indicates correct responses, Roman type indicates incorrect responses.
[a]1 = *a little*, 2 = *very*. [b]Typically developing children.

The errors made by the two groups in the Facial Discrimination Task were computed as an emotional bias score, reflecting the error size and trend (overly positive vs. negative responses). This Facial Discrimination Task bias score was obtained by calculating an error ranking for each response (plus one point per degree in the positive trend and minus one point per degree in the negative trend). For example, a 2-point positive score was assigned when the participant said *a little happy* instead of *a little sad.* Adults with Down syndrome (*M* score = 7.35, *SD* = 8.44) responded more positively than did the controls (*M* = 4.64, *SD* = 4.37), although this difference was not statistically significant. However, effect size, as measured by Cohen's *d*, relative to controls was between medium and large, *d* = .63. This finding suggests an outcome that would probably be significant and of practical importance if the sample size were increased.

Correlations Among Facial Discrimination Task, Cognitive Tasks, and CA

Pearson correlations were undertaken to investigate associations among the Facial Discrimination Task main scores, the cognitive measures, and CA in the Down syndrome group. As can be seen in Table 2, the vocabulary score (PPVT-R-F) correlated significantly and positively with the recognition of the neutral expression, $r = .68$, $p = .003$, and negatively with the happy expression, $r = -.68$, $p = .002$. A significant negative correlation was observed between the mean score on the verbal inhibition task (day–night) and the Facial Discrimination Task bias score, $r = -.77$, $p < .0001$. General nonverbal reasoning ability

(Raven Coloured Progressive Matrices) and CA were not significantly related to any Facial Discrimination Task scores. In the control group, no significant correlations were observed between Facial Discrimination Task scores, PPVT-R-F, and CA.

3.3 Correlations Between Face Processing Tests and Facial Discrimination Task

Finally, we analyzed the relationships between Face Processing Tests and the Facial Discrimination Task, using nonparametric correlations. In the Down syndrome group, we observed a significant relationship between the recognition of surprise (Face Processing Tests) and the neutral expression (Facial Discrimination Task), $\tau = .74$, $p < .0001$. A significant positive relation also appeared between the recognition of the neutral expression and the Face-Sim Identity Matching subtest (face complete and similar), $\tau = .48$, $p = .015$. No significant relationship was found for the control group.

4 Discussion

Our purpose in this study was to investigate face and emotion processing ability of adults with Down syndrome. We administered various tasks presenting facial stimuli with and without emotional content, and compared the results with those of a control group matched on a receptive vocabulary task. In the Face Processing Tests, no significant differences were found between the two groups on the Identity Matching Test. On the emotional tasks, the adults with Down syndrome had more problems matching faces according to emotional expressions, particularly with the recognition of the neutral and surprised expressions. In attributing emotional intensity, they performed very well when identifying the very happy faces, whereas the control group was easily able to identify the very happy faces, but also the very sad ones.

The Down syndrome group performed relatively well on the first two subtests (Complete \[chFaces Dissimilar/Similar), and their results on the Identity Matching Test did not differ from those of the control group. This seems to suggest that these adults do not have difficulties when processing faces that are presented in their entirety, which is consistent with the findings of studies of children with Down syndrome (Williams et al., 2005; Wishart & Pitcairn, 2000). On the other hand, the Down syndrome group's performance dropped to chance in the last three subtests, in which some features (ears, hair, eyes) were concealed. The children in the control group were also unable to execute the last two subtests, suggesting that the difficulties encountered by the Down syndrome group might be related to MA. According

to Bruce et al. (2000), the various subtests from the Identity Matching Test are designed to favor a particular face processing strategy (featural vs. configural), depending on the stimuli presented. When faces have similar features, or when certain features are masked, this impairs the featural processing strategy (analysis of the individual features of the face) because it disrupts analysis focusing on the main features (e.g., eyes, mouth) (Carey & Diamond, 1977; Freire & Lee, 2001; Tanaka & Farah, 1993). In this case, a configural processing strategy (analysis of the relations between facial features) is required. These results suggest that the adults with Down syndrome favored a featural processing strategy as did the children in the control group, who failed the last subtests. Results for the children in the control group were similar to those found by Bruce et al. and consistent with the developmental literature. Indeed, researchers have reported that young children favor a featural over a configural strategy when processing facial stimuli. During the course of childhood, the use of the featural strategy will decrease and a configural strategy will be employed more frequently (Itier & Taylor, 2004; Taylor, Batty, & Itier, 2004). Concerning the processing strategy used by adults with Down syndrome, it remains unclear whether they present a simple developmental delay or use atypical processing strategies. Indeed, the last two Identity Matching subtests may have required additional cognitive demands (such as attentional skills), which may have compromised the success of participants with Down syndrome. It would, therefore, be very interesting to further investigate face processing in this population by administering adapted tasks in order to reduce the additional cognitive demands. To clarify face processing strategies by individuals with Down syndrome, it would also be important to present stimuli in different conditions, such as modified faces or inverted faces as well as to study these abilities along a developmental trajectory.

On the Emotion Identification Test, we observed that adults with Down syndrome showed a significant impairment in processing the expression of surprise, whereas their identification of happiness, sadness, and anger did not differ from that of children in the control group. Wishart and Pitcairn (2000) reported a deficit in processing the expression of surprise for children with Down syndrome (age range 8 to 14 years), which suggests that identification of this expression does not improve with increasing age. In our study, the Down syndrome group showed particular difficulties in the emotion matching conditions, although the reason remains unclear. We observed that both the adults with Down syndrome and the younger children tended to match the faces according to their identity rather than their emotional expression. They seemed to find it difficult to inhibit facial identity and focus on the facial expression. It is also possible that the task instructions might have been more

difficult to understand with the concept of "feeling the same way," leading to a misinterpretation of the task. This hypothesis may be corroborated by the significant positive relationship found in the Down syndrome group between this emotion matching condition and the passive vocabulary measure.

Regarding the results of the Facial Discrimination Task, we observed that the proportion of neutral faces correctly rated by the Down syndrome group was significantly lower than that of the control group. On the other hand, their recognition of faces expressing happiness and sadness did not differ statistically from that of the controls. When rating emotional intensity, the Down syndrome group showed a propensity to maximize positive emotions and minimize negative ones. The response pattern of the control group was dissimilar: They tended to intensify both happy and sad emotions. Moreover, analysis of the adults' error pattern suggests a tendency to judge faces more positively than did children in the control group. In light of these observations, we suggest that the Down syndrome group presents a positive bias in assessing emotional facial stimuli. High performance in rating happy emotions was also observed by Kasari et al. (2001) in children with Down syndrome, but the children had a strong tendency to substitute a positive emotion for a negative one. Investigations of developmental trajectory, including a measure of emotion intensity attribution, could be of great interest in providing a more qualified response pattern in the Down syndrome population.

As seen previously with children (Williams et al., 2005; Wishart & Pitcairn, 2000), the adults with Down syndrome in our study did not show particular difficulties when processing complete faces without emotional expressions (Identity Matching subtests 1 and 2). This supports the hypothesis that they have a specific emotional deficit, because they performed successfully on facial tasks of comparable complexity and abstraction (Rojahn, Rabold, & Schneider, 1995). These data did not support the theoretical position that sustains preserved basic emotion-perception skill in people with mental retardation (D. G. Moore, 2001; D. G. Moore, Hobson, & Lee, 1997), at least in people with Down syndrome. The Moore (2001) literature review, in which Moore examined in detail the issue of a specific emotion deficit versus preserved basic skills in people with mental retardation, included participants whose mental retardation etiology was unknown (e.g., Maurer & Newbrough, 1987b; McAlpine, Kendall, & Singh, 1991) or not examined (e.g., Simon et al., 1996). Nevertheless, in the majority of recent studies conducted in the population with mental retardation, researchers have reported a substantial variability in emotional abilities depending on the etiology. The emotion specificity hypothesis could be further considered in this new context.

Several hypotheses may now be considered in order to better understand the emotional impairments showed by the Down syndrome group. First, we might question the relationship between general cognitive abilities and emotional processing. Even though this issue has been examined by many authors, opinions still remain diverse (Dawson, Webb, & McPartland, 2005; Gagliardi et al., 2003; Rojahn, Lederer, & Tassé, 1995). In our study, results on the various emotional tasks did not correlate significantly with the Raven Coloured Progressive Matrices raw score. Therefore, these results show that the recognition of facial emotional expressions is not directly related to a general nonverbal reasoning capacity. These findings contradict the assumption that emotion recognition is related to MA in adults with mental retardation (Moore, 2001; Simon et al., 1996) and suggest that it would be appropriate to offer emotion-based programs to people with Down syndrome.

It seems that more specific abilities may be involved, such as receptive vocabulary. Indeed, we did observe a significant positive correlation between the receptive vocabulary task (PPVT-R-F) and the surprised and neutral expressions, which were less well-recognized by the adults with Down syndrome. Consequently, one can assume that recognition of these two expressions might require more complex semantic representation (e.g., surprise can be associated with a positive or a negative event) than joy, sadness, or anger. Nevertheless, the absence of any relationship between the PPVT-R-F score and the recognition of neutral or surprise stimuli in the control group might invalidate this hypothesis and suggest instead a particular emotional deficit inherent in individuals with Down syndrome. Indeed, these two expressions were easily recognized by the child control group. A significant negative correlation was also observed in the Down syndrome group between the PPVT-R-F score and the recognition of happy expressions (Facial Discrimination Task), showing that, paradoxically, adults with Down syndrome, who were better at recognizing the happy faces, had a poorer receptive vocabulary score. This result may be related to the positive bias: Participants who had difficulty recognizing neutral expressions might have had the tendency to respond *happy* more often during the test, which resulted in a very high score for this emotion. Moreover, we observed that adults with Down syndrome often confused the expression of surprise with the expression of happiness (probably because of the wide-open mouth in both expressions), which also supports the hypothesis of the positive bias. The poorer recognition of the neutral expression by the Down syndrome group may be related to structural specificity. Indeed, in neutral faces, the features (e.g., mouth, eyes, and eyebrows) are less prominent than in other expressions (Guizatdinova & Surakka, 2005). This hypothesis is supported by the significant positive relationship between the neutral expression score and

the Identity Matching subtest Face-Sim (face complete and similar) in the Down syndrome group, indicating that the participants who were better at recognizing the neutral stimuli were also more accurate in matching similar faces. The Facial Discrimination Task design (a choice among three options) also offers the possibility of succeeding by deduction (if the face is neither happy nor sad, it must be neutral). Because the adults with Down syndrome performed well on the recognition of happy and sad expressions, one might expect them to use the exclusion strategy when neutral faces were presented. Instead, they showed a tendency to propose the happy expression and demonstrated a positive bias throughout the task. The preference for more positive emotions exhibited by people with Down syndrome may be difficult to inhibit, particularly when they face new or puzzling situations, a hypothesis that seems to be supported by the strong correlation between the bias score and the verbal inhibition measure (day–night task). In order to further investigate the processing of this expression by adults with Down syndrome, we are planning additional research in which we will use some tasks involving neutral faces under different conditions (identification, matching). An experimental design should be used to allow the counterbalancing of the administration of emotional tasks, in order to control for the potential influence of task presentation on participants' performances. In this study we decided to present the emotional tasks according to their level of difficulty: The tasks with the easiest instructions were administered first in order to encourage the participants. However, we paid careful attention to the motivation and attentional level of all participants, which allowed us to control this drawback as much as possible. Because our results show that some specific competences were involved in the emotional tasks (inhibition and receptive vocabulary), it will be of great interest to add other cognitive measures, such as productive vocabulary or attentional abilities to our experimental design.

Finally, these findings lead us to reflect on the possible implications of this emotional impairment for other aspects related to the social sphere. Soresi and Nota (2000) observed that young adults with Down syndrome present deficits in interpersonal relationships, with problems maintaining appropriate interactions. Their difficulty in recognizing neutral expressions and their tendency to interpret other people's emotional states as too positive may be linked to socially inappropriate behavior. Indeed, when faced with a partner who is expressing no particular emotion, a person with Down syndrome may not correctly understand the other's emotional state and, thus, his or her reaction may be maladjusted. More detailed investigations in this area are required. Moreover, it would be very interesting to determine the facial emotional recognition pattern in children and adolescents with Down

syndrome, as well as adults, in order to study the developmental trajectory of their emotional processing. The comparison of the emotional pattern in individuals with Down syndrome with that of people who have other genetic disorders associated with mental retardation will also be important in the future, in order to verify whether the atypical pattern observed in our population is specific to Down syndrome. Our findings emphasize the relevance of a more qualitative approach, analyzing a complete response pattern for facial emotional recognition and using the emotion intensity rating. The experimental design provides a more accurate emotional processing profile of people with Down syndrome and opens up the possibility of designing an early rehabilitation program to improve their social behavioral skills.

ETUDE 2

From facial emotional recognition abilities to emotional attribution: A study in Down syndrome[32, 33]

Abstract

Facial expression processing and the attribution of facial emotions to a context were investigated in adults with Down syndrome (DS) in two experiments. Their performances were compared with those of a child control group matched for receptive vocabulary. The ability to process faces without emotional content was controlled for, and no differences appeared between the two groups. Specific impairments were found in the DS group according to the task modalities and the type of facial emotional expressions. In the emotion matching condition, the DS adults showed overall difficulties whereas in the identification and recognition conditions they were particularly impaired when processing the neutral expression. In the emotion attribution task, they exhibited difficulties with the sad expression only and the analysis of their error pattern revealed that they rarely selected this expression throughout the task. The sad emotion was the only one that showed a significant relationship with the facial expression processing tasks.

[32] This study is a reprint of the article: Hippolyte, L., Barisnikov, K., Van der Linden, M., & Detraux, J.-J. (2009). From facial emotional recognition abilities to emotional attribution: A study in Down syndrome. *Research in Developmental Disabilities, 30*, 1007-1022.

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1 Introduction

People with Down syndrome (DS) have traditionally been characterized as friendly and very sociable (Carr, 1995; Dykens, Hodapp, & Evans, 1994; P. Gunn & Cuskelly, 1991). However, the recent literature emphasizes emotional and social behavioural problems in this population (Coe et al., 1999; Fidler, Most, & Philofsky, 2008; Jahromi, Gulsrud, & Kasari, 2008), yet the mechanisms underlying these difficulties remain relatively unexplored. The ability to lead successful social interactions can be seen as a complex process which relies on an intricate array of interacting cognitive, relational and emotional competences (Bach, Happe, Fleminger, & Powell, 2000; Carlson et al., 1998). In particular, the ability to recognize facial emotional expressions and to understand the emotional states of others are considered as skills central to develop and maintain adequate social relationships.

Studies investigating emotion processing in DS children generally reported difficulties with some specificities regarding the recognition of particular expressions. Some studies found impairments for the expressions of anger (Kasari et al., 2001; Porter et al., 2007) and surprise (Wishart & Pitcairn, 2000), whereas several of them stressed difficulties with the recognition of fear (Kasari et al., 2001; Porter et al., 2007; Williams, Wishart, Pitcairn, & Willis, 2005; Wishart, Cebula, Willis, & Pitcairn, 2007; Wishart & Pitcairn, 2000). The error patterns in the emotional tasks have been investigated by few authors. Kasari et al. (2001) and Porter et al. (2007) reported a tendency to misidentify negative emotions as positive ones, which could not be repeated in Williams et al.'s (2005) or Wishart et al.'s (2007) studies. Despite the inconsistencies of the results, it emerges that the recognition of negative emotions is more problematic for DS children than that of positive ones. In fact, all studies reported their relative strength in processing the expression of joy. It is to be noted that the above studies concerned children and young adolescents with DS; the adult population was surprisingly left out. Yet, a large majority of these studies found that neither chronological age (CA) nor developmental age were related to better performances in the emotional tasks. In addition, Williams et al. (2005) observed that DS adolescents up to 17 years old did not outperform their younger peers, findings which suggested that adults and children with DS should present a similar response pattern.

In a recent study, Hippolyte, Barisnikov and Van der Linden (2008) investigated facial emotion recognition in DS adults (CA = 33.3 years), whose results were compared with those of a control group composed of typically developing (TD) children matched for receptive

vocabulary (EVIP-R, Dunn, Thériault-Whalen, & Dunn, 1993). The capacity to process facially expressed emotions was examined through three modalities: identification, matching and recognition. The emotion identification and matching tasks assessed the expressions of joy, sadness, anger and surprise. The recognition one assessed the expressions of joy, sadness and neutral, as well as the intensity attribution for joy and sadness. An additional task without emotional content (matching faces according to identity criteria) was administered to control for basic face processing skills. The main findings reported a specific impairment in the DS participants for the surprise expression (identification task) and the neutral expression (recognition task), while they did not differ from the control group in the face processing control task. Concerning the emotion matching task, Hippolyte et al. also reported that the DS adults performed, on the whole, poorer than their controls. Several facial expressions were significantly related to the receptive vocabulary measure, and this relation was particularly strong with the neutral expression. When rating intensity, the DS adults showed a propensity to maximize the items of joy and minimize the items of sadness, while the investigation of their error patterns suggested the presence of a positive bias in judging facial stimuli. Some similarities appeared between the DS adult group's results and previous findings observed in DS children. Firstly, the DS adults did not differ from their control group in the task involving facial stimuli without emotional content, results which have also been found in several other studies (Williams et al., 2005; Wishart et al., 2007; Wishart & Pitcairn, 2000). In relation to the facial expression tasks, the difficulty to recognize the surprise expression had been observed by Wishart et al. (2000) as well, suggesting that the processing of this emotion did not improve with CA. Finally, the positive bias found in the DS adults' assessment of the facial stimuli might be related to the response pattern shown in children by Kasari et al. (2001) and Porter et al. (2007).

The aim of the present study was twofold. In Experiment 1, our objective was to replicate Hippolyte et al.'s previous study. No other studies had been published on emotion recognition abilities in the DS adult population, and our understanding of this issue remains limited. As such, some methodological modifications were introduced in their experimental design in order to increase the sensibility of the tasks (the addition of trials and distracters). In Experiment 2, the objective was to explore the DS adults' abilities to attribute a facial emotion to a social context. To our knowledge, these emotional attribution skills have never been investigated in this population, whereas we found only three studies exploring them in DS children. Each of these studies proposed a different experimental task. In Turk and Cornish's study (1998), the experimenter presented the participants with four drawings

depicting a faceless figure in different social contexts (e.g., getting an ice-cream, being chased by a dog) and explained what was happening to the figure. Participants were then asked to point to the response card (four schematic drawings of the emotions of joy, sadness, anger and fear) which best suited the emotion experienced by the figure. For this task the DS children obtained a poorer global performance than that of the control group (children matched on the EVIP-R vocabulary scale). In Wishart and Pitcairn's study (2000), participants had to choose from three photographs of the same individual portraying different emotions (photos taken from Ekman & Friesen, 1976) the photo that corresponded to a brief verbal story told by the experimenter (e.g., receiving a present). Six items assessing the emotions of joy, surprise, sadness, fear and disgust were proposed in this task. The DS children obtained a lower global score than that of their control group (children matched on the basis of performance on the Kaufman Facial Recognition subtest, Kaufman & Kaufman, 1983), but this difference remained non significant. Finally, Kasari et al. (2001) examined emotion attribution abilities through a puppet paradigm in which the emotional situations were acted out by a puppet that had an expressionless face (e.g., puppet is taken to zoo by mother). The emotions of joy, sadness, anger, and fear were assessed (two items per emotion), but Kasari et al. did not specify how participants' responses were gathered. A series of three experiments were presented. In the first one, the results of the DS children did not differ from those of TD children matched for mental age (Standford-Binet Intelligence Scale, Thorndike, Hagen, & Sattler, 1986). In the second, the DS group performed significantly poorer on the items of anger and fear than their two control groups (TD children and children with ID of unknown aetiology). The third experiment tracked the progress of the DS children who had participated in Experiments 1 and 2 over a 2-year period, but no significant improvements were observed in the attribution task.

The findings of the above studies tend to show that DS children have global difficulties in attributing facial emotion according to a context. However, the variety of the situations proposed (drawing, story, scenario enacted) makes it difficult to infer a reliable response profile from these results. In addition, the limited number of items (one or two per emotion) used in these studies restrict the significance of their results and impede the possibility to pursue separate analyses per emotion. Finally, we do not know if the participants' abilities to recognize the emotions to be attributed were controlled for. This issue might be problematic as these abilities constitute a prerequisite to solve the attribution task. Moreover, the children in these studies were generally impaired in the other emotion processing tasks they were presented. As these studies did not report results from correlation

analyses between these two types of tasks, we have no information at our disposal about this point.

The task we proposed in Experiment 2 was specifically created for people with mild to moderate intellectual disability (ID). The task instructions were short and simple to avoid additional information processing loads, and the responses did not require a verbal answer. The emotions of joy, sadness, anger and fear were assessed by means of four to five items per emotion. Finally, in our study we examined the relationships between the facial expression tasks presented in Experiment 1 and the emotion attribution task presented in Experiment 2. In addition, relations between these experimental tasks and specific cognitive competences were investigated. The DS adults' results were compared to those of TD children matched on receptive vocabulary, a matching measure which is frequently chosen in studies on emotion processing in people with ID (Bieberich & Morgan, 2004; Hippolyte et al., 2008; Turk & Cornish, 1998).

Experiment 1

In Experiment 1, we aimed to further explore the DS adults' abilities to process facial expressions by following Hippolyte et al.'s previous work. We therefore replicated their experimental design in order to see if similar results could be obtained. We also wanted to further examine the processing of the neutral expressions for which very impaired recognition was found in the DS adults group. New items for this expression were introduced in the identification and matching conditions allowing a more in-depth investigation.

2 Method

2.1 Participants

Twenty-four adults with DS took part in the study (17 men, 7 women), all with a moderate ID. All participants had a medical diagnosis of Trisomy 21 and were recruited from a sheltered workshop. DS adults with significant sensory, psychiatric or physical disabilities, as well as clinical symptoms of dementia were excluded from participation. The mean age of this group was 34.3 years (*SD* = 7.1). The adults were individually matched on gender and receptive vocabulary level (raw score) with a control group comprised of 24 TD children attending an elementary public school (mean age = 5.9, *SD* = 1.6). The receptive vocabulary task was the French adaptation (EVIP-R, Dunn et al., 1993) of the Peabody Picture

Vocabulary Test – Revised (Dunn & Dunn, 1981). A Student t-test confirmed that no significant differences appeared between the two groups on this matching measure, $t(46) = -.186$, $p = .85$.

Table 1. Participants' mean results for the receptive vocabulary task (developmental age) and the Nepsy selective attention subtests, Rabbits and Faces (precision scores and time response).

	Receptive vocabulary		Selective attention							
			Rabbits				Faces			
			Precision[1]		Time		Precision[1]		Time	
	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)
DS	6;5	(2;8)	17.8	(3)	112.1[a]	(43.6)	4.1	(7.8)	170.7[c]	(20.2)
Controls	6;6	(2;3)	19	(1.3)	75.9[b]	(31.2)	8.2	(8.4)	148.5[d]	(43.4)

Note. [1] Maximum precision score = 20 for each subtest.
a > b, $p < .01$; c > d, $p < .05$

Two selective attention subtests (Rabbits and Faces) taken from the neuropsychological battery Nepsy (Korkman, Kirk, & Kemp, 2003) were administered to all participants in order to check for its potential influence on the experimental tasks (see Table 1). In the first subtest Rabbits, participants were asked to search for target pictures (rabbits) among dissimilar distracters (e.g., apple, tree, and dog). The second subtest Faces was more complex as two targets (two specific faces) had to be found among similar distracters (other faces). The time was limited to 180 seconds for each subtest, and participants were instructed to proceed as quickly as possible. The two groups did not significantly differ on the precision score (number of hits minus false alarms) for both subtests (Rabbits: $p = .061$, Faces: $p = .092$), but the DS adults took significantly more time to achieve them (Rabbits: $p = .002$, Faces: $p = .028$). The correlations between these two subtests were highly significant and the precision score for the Faces subtest only was kept so as to not enlarge the subsequent analyses (Rabbit subtest was realized near the ceiling by the two groups). Finally a nonverbal reasoning task was administered to the DS adults (Raven's Coloured Progressive Matrices, CPM, Raven, Court, & Raven, 1998). They obtained a mean raw score of 16.08 ($SD = 5.27$), corresponding approximately to an IQ of 60.

2.2 Procedure and Materials

The capacity to process facial expressions was examined through three types of tasks (Expression Identification, Expression Matching and Facial Discrimination), while the ability to process faces without emotional content was assessed through the Identity Matching test. All stimuli were monochrome photographs of children's faces, with the exception of the Facial Discrimination task which presented adults' faces (see Hippolyte et al., 2008 for details). These tasks were administered in a counterbalanced order and two to four sessions were necessary (25 to 35 minutes each) to complete them depending on the participants' fatigue and motivation. These sessions took place over approximately one to two weeks. All participants were tested individually in a quiet room at their workplace or at school. The research was approved by the Ethics Committee of the University of Geneva and authorisations from the institution, the legal tutors of the DS adults, and the school were obtained. Participants gave their oral consent to take part to the study, and were free to withdraw from the procedure at any time.

2.2.1 Identity Matching Test

The Identity Matching test assessed the ability to match faces on the basis of their identity, and was used in this experiment as a control measure for basic face processing skills. This task, originally taken from the battery Face Processing Tests (Bruce et al., 2000), was composed of five subtests of increasing difficulty. The subtests 1, New Face-Dis and 2, New Face-Sim constituted adapted versions (respectively called Face-Dis and Face-Sim in Bruce et al.'s battery) to which a second distracter had been added, whereas the subtests 3 to 5 had not been modified. Each of these five subtests consisted of 16 items and had a similar design: a target face was shown at the top of the page and participants had to identify the target face (out of three faces for subtests 1 and 2 and out of two faces for subtests 3 to 5) at the bottom of the page. One trial item was offered for the first three subtests to ensure comprehension of the task.

The first two subtests New Face-Dis and New Face-Sim presented complete faces with distracters respectively dissimilar and similar (same versus different gender, age and general appearance). The subtest 3, Maskedface-Dis, and 4, Maskedface-Sim, presented faces that were dissimilar/similar, respectively, with the hair and ears concealed. The subtest 5, Eyesmasked-Sim, presented similar faces with hair, ears, and eyes concealed. The last three subtests were processed with difficulty by all participants in Hippolyte et al.'s study, and rough difficulty in Bruce et al.'s (2000) study, which showed that the success rates were not above the level of chance before the age of 7 or 8 for the subtests 4 and 5. These last three

subtests were assessed in this experiment to see if Hippolyte et al.'s previous results could be replicated.

2.2.2 Expression Identification and Expression Matching Tasks

The Expression Identification and the Expression Matching tasks were adapted from two tests of the Bruce et al.'s battery (respectively called Emotion-Id and Emotion-Match). The number of the distracters had been increased (two instead of one in the original version) and a new expression (neutral) had been inserted. For the Expression Identification task which was found easier to execute than the Expression Matching task in Hippolyte et al.'s study, an additional item per facial expression had been added to increase the task demand. Both tasks assessed five facial expressions: joy, sadness, anger, surprise and neutral.

In the Expression Identification task (20 items) participants were shown the stimuli of three faces which were placed next to another, and had to point to the face that displayed a particular emotion named orally by the experimenter (4 items per expression). In the Expression Matching task (15 items), a target face was shown at the top of the page and the participants were asked to point to the face at the bottom (out of three) that displayed the same expression as the top one (3 items per expression). One trial item was administered in this task.

2.2.3 Facial Discrimination Task

The Facial Discrimination task (Rojahn, Rabold, & Schneider, 1995) assessed facial expression recognition and emotion intensity attribution. It consisted of 41 photographs presenting three expressions: happy, sad, and neutral. The participants had to indicate whether a given item depicted a happy face, a sad face, or a face that was neither happy nor sad (neutral). If the response was happy (or sad), they were asked to decide between two intensity levels for that emotion. Level 1 was for a face that was 'a little' happy or sad and level 2 for a face that was 'a lot' happy or sad. Participants had a training session with 6 items, before performing a test which consisted of randomly presenting 12 happy faces (9 for the first level, 3 for the second), 12 neutral faces and 11 sad faces (7 for the first level, 4 for the second). In addition, an emotional bias score reflecting error size and trend (overly positive versus negative responses) could be computed for this task. This measure was obtained by calculating an error ranking for each response (plus one point per degree in the positive trend and minus one point per degree in the negative trend). For example a 1-point positive score was assigned when the participant said 'very happy' instead of 'a little happy'.

3 Results

The assumption of a normal distribution using one-sample Kolmogorov-Smirnov tests was tested for all experimental tasks variables (separately for each group). A normal distribution was found for the Identity Matching Test and the Facial Discrimination Task allowing us to conduct parametric analyses. Some of the variables of the two facial expression tasks Expression Identification and Expression Matching did not follow a normal distribution, and non parametric analyses were run for these tasks.

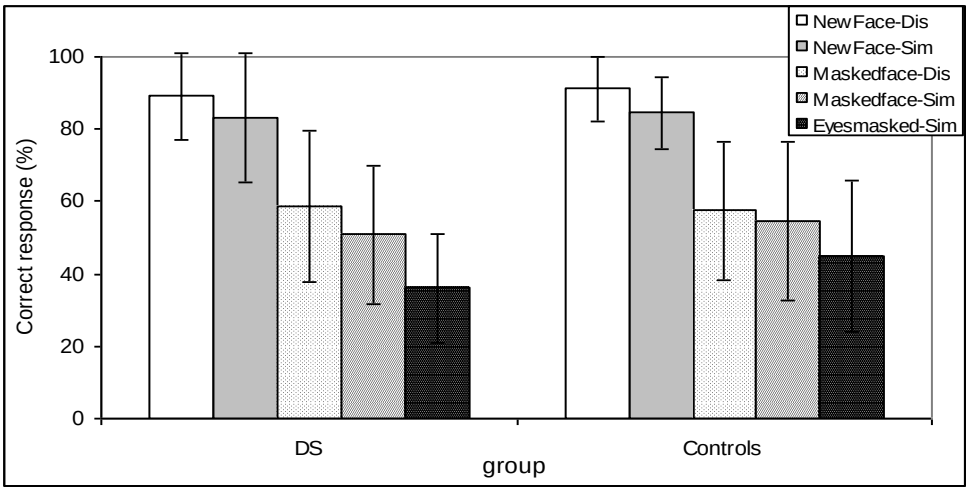

Figure 1. Mean percentage of correct responses in each of the five Identity Matching subtests for the two groups.

3.1 Identity Matching Test

The Identity Matching test data were analysed by means of a 2 (group) X 5 (task) repeated-measure ANOVA. Figure 1 illustrates percentage scores (per group) for the five subtests. There was a significant main effect of task, $F(4,176) = 91.75$, $p < .0001$, $\eta^2 = .675$, but no effects of group, $F(1,44) = .69$, $p = .41$, $\eta^2 = .015$, nor interaction, $F(4,176) = .07$, $p = .58$, $\eta^2 = .015$. Subsequent Bonferroni post-hoc comparisons showed that the first two subtests New Face-Dis and New Face-Sim presenting complete faces were equally well realized by the two groups, and significantly better than the three subtests Maskedface-Dis, Maskedface-Sim, and Eyesmasked-Sim.

3.2 Expression Identification and Expression Matching Tasks

Table 2 presents the main results for the Expression Identification and Expression Matching tasks, as well as the outcomes of the statistical inter-group analysis (Mann-Whitney *U* tests). In the Expression Identification task, the DS group's performances were significantly

lower than these of the control group for all expressions, except sadness. Intra-group analyses were pursued using Wilcoxon signed-rank test. In the DS group, expressions of joy and anger were significantly better recognized than the expressions of sadness (*ps* < .01), surprise (*ps* < .02), and neutral (*ps* < .001). Whereas no significant differences appeared between the expressions of sadness and surprise, the neutral expression was the worst recognized (*ps* < .01). In the control group, the score for the emotion of sadness was significantly poorer than the scores for the emotions of joy (*p* = .005), anger (*p* = .001) and surprise (*p* = .037).

Table 2. Mean raw scores of the two groups on the Expression Identification and Expression Matching Tasks

Tasks	max. score	DS		Controls		Mann-Whitney	
		Mean	(*SD*)	Mean	(*SD*)	U	*p*
Expression Identification							
Joy	4	3.29	(.99)	3.79	(.41)	206	.042
Sadness	4	2.42	(1.24)	2.88	(1.22)	227	.192
Anger	4	3.38	(.82)	3.96	(.20)	166.5	.001
Surprise	4	2.63	(1.34)	3.5	(.93)	180	.015
Neutral	4	1.63	(.82)	2.92	(1.13)	116	.000
Expression Matching							
Joy	3	1.87	(.75)	2.75	(.44)	105	.000
Sadness	3	1.43	(1.08)	2.63	(.64)	103	.000
Anger	3	1.3	(1.10)	2.42	(.71)	122	.001
Surprise	3	1.35	(.88)	1.75	(.84)	211	.136
Neutral	3	1.17	(.98)	2.17	(.86)	128	.001

Relating to the Expression Matching task, Mann-Whitney analyses showed that the DS adults obtained significantly lower scores than their controls for all expressions, except surprise. The main results for the intra-group analyses revealed that the expression of joy was significantly better recognized by the DS participants than neutral (*p* = .006) and surprise (*p* = .043). No significant differences appeared between the other four expressions. In the control group, the expressions of joy and sadness were significantly better processed than the expressions of surprise (*ps* < .001) and neutral (*ps* < .01).

3.3 Facial Discrimination Task

A 2 (group) X 3 (expression) repeated-measure ANOVA was first conducted, taking into account the scores (percentages) for the happy, sad and neutral expressions (see Figure

2). The analysis revealed that there were significant main effects of group, $F(1,46) = 29.37$, $p < .0001$, $\eta^2 = .394$ and expression, $F(2,90) = 9.64$, $p < .001$, $\eta^2 = .197$. A significant interaction between expression and group, $F(2,90) = 12.87$, $p < .0001$, $\eta^2 = .211$, was also observed. Bonferroni post-hoc comparisons revealed that the DS adults recognized fewer neutral items than their controls, $p < .0001$. The DS group identified both sad and happy expressions ($ps < .0001$) more easily than the neutral ones, while no significant differences appeared between the three expressions for the control group.

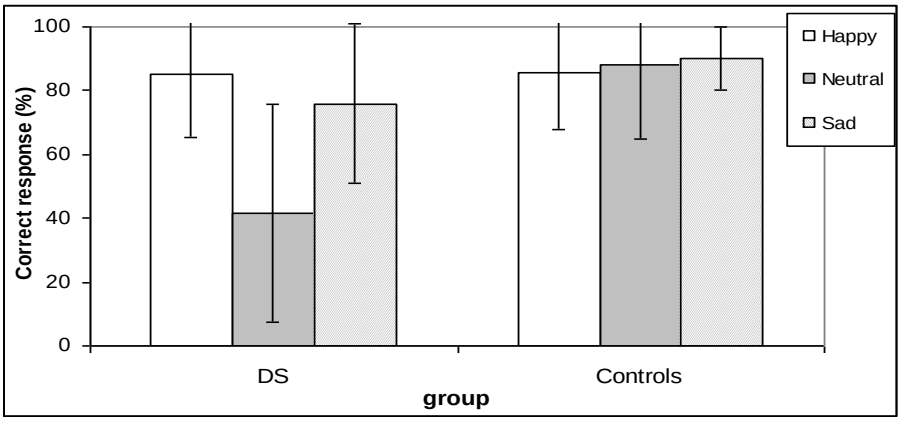

Figure 2. Mean percentage of correct responses (per expression) in the Facial Discrimination task for the two groups.

A 2 (group) X 2 (emotion) X 2 (intensity) repeated-measure ANOVA was then performed to determine whether groups differed when rating the emotional intensity of the sad and happy emotions. The analyses revealed two significant main effects: group, $F(1,45) = 17.99$, $p < .001$, $\eta^2 = .285$, and intensity, $F(1,45) = 51.11$, $p < .0001$, $\eta^2 = .531$. There was no significant interaction between group and emotion ($p = .13$), and group and intensity ($p = .14$), but there was a marginal effect of the triple interaction group X emotion X intensity, $F(1,45) = 3.21$, $p = .079$, $\eta^2 = .066$. Post-hoc Bonferroni tests showed that the DS group identified the very happy faces significantly better than all the other expressions ($ps < .05$). The faces with very sad expressions were better recognized than ones with little happy expressions ($p < .001$). No differences were found between the recognition of little and very sad expressions ($p = .254$). The control group showed a similar pattern, but their results did not differ between the very happy and very sad faces ($p=.98$), which were similarly recognized.

Finally, we analysed the error pattern of the two groups by carrying out an analogous error analysis like the one proposed in Hippolyte et al.'s study. We observed that the large majority of the participants rarely selected an emotion in the opposite hedonic tone (e.g., happy for sad) when they gave an incorrect answer. We also noticed that the DS group tended

to propose the emotion of joy more often than the emotion of sadness and instead of the neutral expression. Participants with DS obtained an emotional bias mean score of 11.95 (*SD* =14.5) which was significantly greater than the one obtained by their controls (score = 2.29, *SD* = 4.34) (t = 3.11, p = .003).

3.4 Correlations between the three facial expression tasks, CA, and cognitive tasks

A series of correlations were run to investigate the relationships between the three facial expression tasks, CA and the cognitive tasks. Significant relations appeared in the DS group with all the cognitive tasks (see Table 3), but the most significant among them was found with the receptive vocabulary measure, which was related to several expressions within the three tasks. More particularly, a strong relation was found in the Facial Discrimination task with the neutral expression (r = .66, p = .001). The nonverbal reasoning score and the selective attention measure were related to the Expression Identification and Expression Matching task to a lesser extent.

In the control group, we observed that CA was strongly related to cognitive measures; full and partial correlations were therefore run controlling for CA. The main results showed that the expression of sadness was related to CA in the three facial expression tasks (Identification: τ = .38, p = .018; Matching: τ = .49, p = .004; Discrimination: r = .42, p = .034). For the Expression Matching task, CA was also related to surprise (τ = .32, p = .046) and neutral (τ = .42, p = .009). The significant relations observed between the facial expression tasks and the EVIP-R score were not preserved after controlling for CA. For the selective attention measure, a significant relation remained with the neutral expression score in the Expression Matching task (r = .53, p = .008).

Table 3. Correlations between the Expression Identification and Expression Matching Tasks (Tau-B), Facial Discrimination Task (Pearson), chronological age and cognitive measures in the DS group

Variables	CA	EVIP-R	Nepsy Faces	CPM Raven
Expression Identification				
Joy	.03	.29	.28	.36*
Sadness	.30	.26	.15	.25
Anger	-.06	.35*	.18	.47**
Surprise	.12	.44*	.45**	.38*
Neutral	.21	.17	.14	.25
Expression Matching				
Joy	-.23	.06	.24	.06
Sadness	-.04	.33*	.26	.24
Anger	-.23	.06	.22	.16
Surprise	-.33	.38*	.24	.32
Neutral	-.09	.34*	.37*	.33*
Facial Discrimination				
Joy	.23	.25	.01	.13
Sadness	-.06	-.15	.08	-.03
Neutral	-.15	.65**	.21	-.35
Bias	.27	.01	.03	.28

Note: *p < .05. **p < .01.

4 Discussion

In Experiment 1, we examined the capacity to process facially expressed emotions through three modalities, namely identification, matching and recognition. The ability to process faces without emotional content was controlled for, and no differences appeared between the two groups in this task. With regard to the facial expression tasks, we noticed important differences in the DS adults' performances depending on the task modality. They were very impaired in the matching condition, whereas they exhibited rather specific difficulties in the identification and recognition task according to the expressions.

Corroborating Hippolyte et al.'s previous findings, the DS group processed the neutral expression very poorly. In addition, the analysis of their response pattern in the recognition

task showed a tendency to assess expressions as being more positive than they actually were. The correlational analyses stressed that in the DS group a particular implication of receptive vocabulary skills was involved in the processing of several expressions. The nonverbal reasoning and selective attention abilities were also related to certain expressions, often together with the vocabulary score.

Experiment 2

The main objective of Experiment 2 was to explore the DS adults' ability to attribute a facial emotion to a context, since to our knowledge this issue has never been examined with this particular population. For this purpose, we used a new task specifically created for people with mild to moderate ID. Furthermore, we aimed at investigating the relationships between these emotion attribution skills and the emotion processing abilities assessed in Experiment 1. We were also interested in the relations between the attribution task and specific cognitive competences.

5 Method

5.1 Participants

Each of the participants in Experiment 2 had been recruited for Experiment 1. However, three of the adults with DS did not participate in Experiment 2. The two groups of participants in this experiment consisted thus of 21 adults with DS (15 men, 6 women) and 24 TD children (17 boys, 7 girls). The mean age of the DS group was 34.7 years (*SD* = 7.4) and they had a developmental age of 6.6 (*SD* = 2.7) on the EVIP-R vocabulary matching measure. For the Nepsy selective attention subtests, their precision score was of 17.62 (*SD* = 3.18) for the Rabbits (mean response time = 116.05, *SD* = 42.29) and 4.33 for the Faces (*SD* = 7.9) (mean response time = 172.71, *SD* = 16.62). As with Experiment 1, the two groups did not significantly differ on the precision score for both Nepsy subtests, and the DS adults took significantly more time to achieve them (Rabbits: $p = .001$, Faces: $p = .017$). The Faces precision score was kept as well for the subsequent statistical analyses. Finally, the DS group's raw score was of 15.9 (*SD* = 5.44) on the Raven CPM task.

5.2 Procedure and Materials

The experimental task presented in Experiment 2 was administered in one session (15 to 25 minutes). All participants had been assessed with the EVIP-R, the Nepsy selective attention subtests, and the face processing and facial expression tasks (plus Raven CPM for the DS adults) during Experiment 1.

5.2.1 The Emotion Attribution Task

The Emotion Attribution task (Barisnikov, Van der Linden, & Catale, 2004) assessed the ability to infer another's feelings according to a context. Specifically developed for people with mild to moderate ID, it consisted of pictorial material which was simple and easy to handle. Short and explicit instructions were given in order to reduce additional information processing loads, and no oral answers were needed to process the task.

The task was composed of 22 coloured drawings (13cm x 18cm x 3mm) presented in two parts. Part 1 illustrated a young woman (Natacha, 10 items) and part 2 a boy (Marco, 12 items) in their daily social interactions. Each situation underlined a particular feeling: four items arouse the emotion of joy (e.g., opening Christmas presents), five items sadness (e.g., seeing a wounded bird lying on the ground), five items anger (e.g., being splashed with water by a car), and five items fear (e.g., encountering a threatening dog). In all drawings, the main figure's feelings were hidden as her/his face was missing (hole of approximately 3cm x 3cm x 3mm). For each figure, five facial expressions (joy, anger, sadness, fear and neutral) were represented on little squares which fitted into the drawings.

The participant was introduced to the first part of the task by the experimenter, "I will show you some pictures about a girl called Natacha. You will see, many events happen to her". The instructions were then given, "The pictures I am going to show you are incomplete, Natacha's face is missing. You will have to add it, each time choosing from three faces. You will have to take the face which corresponds best to how Natacha feels in this situation". The five squares representing the above expressions were then presented to the participant one at a time. The experimenter made sure that the participant was able to recognize each of the expressions before introducing the first situation. The testing began with two learning trial items. The experimenter showed the drawing, and gave the instructions, "Look closely at this picture. From these three faces, pick out the one that best shows how Natacha feels in this situation. Once you have decided, you can place it here". The experimenter pointed at the hole where the face was missing. For the first two trial items, the experimenter corrected the answer if wrong, and a reflection was made together with the participant to find out the correct answer. After the trial items the responses were no longer corrected. This procedure

was adopted in order to familiarize the participant with the different facial expressions and the task. The second part of the task relating to Marco's items was then presented. It followed the same procedure as for Natacha, but there was just one trial item and the five faces were proposed each time. Global scores could be calculated (maximum score = 19, part 1 = 8 points, part 2 = 11 points), as well as subscores for each emotional expression.

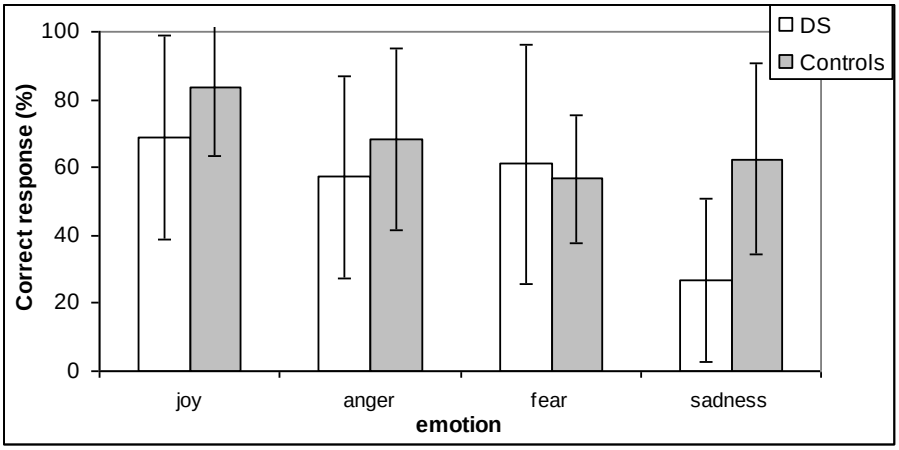

Figure 3. Mean percentage of correct responses for the four emotions of the Emotion Attribution task for the two groups.

6 Results

6.1 Emotion Attribution Task

We first checked for both groups separately to establish if there were significant differences between the scores for Natacha's and Marco's parts. The differences remained non significant (*ps* <.05) and subsequent analyses were performed by merging the two parts of the task. A 2 (group) X 4 (emotion) repeated-measure ANOVA was conducted to determine whether the groups differed on the attribution of the expressions of joy, anger, fear and sadness (scores in percentages) (see Figure 3). The analysis revealed main effects of group, $F(1,43) = 8.43$, $p = .006$, $\eta^2 = .164$ and emotion, $F(3,129) = 12.06$, $p < .0001$, $\eta^2 = .219$. A significant interaction between emotion and group, $F(3,129) = 4.86$, $p = .003$, $\eta^2 = .101$, was also observed.

Bonferroni post-hoc comparisons showed that the two groups only differed for the sad emotion, which was poorly attributed by the DS group ($p < .001$). The DS adults' score for this emotion was significantly lower than the scores for the others expressions (joy: $p < .001$, anger: $p = .003$, fear: $p < .001$). In the control group, no significant differences appeared

between the emotions of joy, sadness and anger, whereas the emotion of fear was more poorly attributed than the emotion of joy (p =.009).

6.2 Error analysis

The confusions committed by the two groups in the Emotion Attribution task were then investigated and Table 4 presents the percentages of responses (correct and incorrect) for each emotion that had to be attributed. The DS group's error pattern revealed specificities and not an overall error spread across all expressions.

Table 4. Emotional expressions given by groups for the Emotion Attribution task (percentage)

	Expected answers							
	Joy		Anger		Fear		Sadness	
Responses (%)	DS	Controls	DS	Controls	DS	Controls	DS	Controls
Joy	**69**	**83**	11	3	11	8	31	12
Anger	7	3	**57**	**68**	16	15	14	12
Fear	8	4	12	4	**61**	**57**	12	6
Sadness	0	3	9	24	5	12	**27**	**63**
Neutral	15	6	10	1	7	8	15	8

Note. Bold type indicates correct responses; normal type indicates incorrect responses.

As with the control group, the DS adults mainly confused emotions of similar valence (e.g., anger instead of sadness). However, this was not the case for the emotion of sadness, which they frequently substituted with the emotion of joy. The error rates (percentages) for each emotion were then compared between the two groups (see Figure 4) using Student t-tests analyses. The DS group showed significantly greater error rates than their controls for the expression of joy (p = .03) and fear (p = .018), whereas no differences appeared between the two groups for neutral (p = .105) and anger (p = .461) expressions. Of interest, the error rate for sadness was larger in the control group (p = .001). Intra-group analyses showed that this error rate was smaller than any of the other expressions (ps < .02) in the DS group, whereas no other significant differences were observed between joy, fear, anger and neutral.

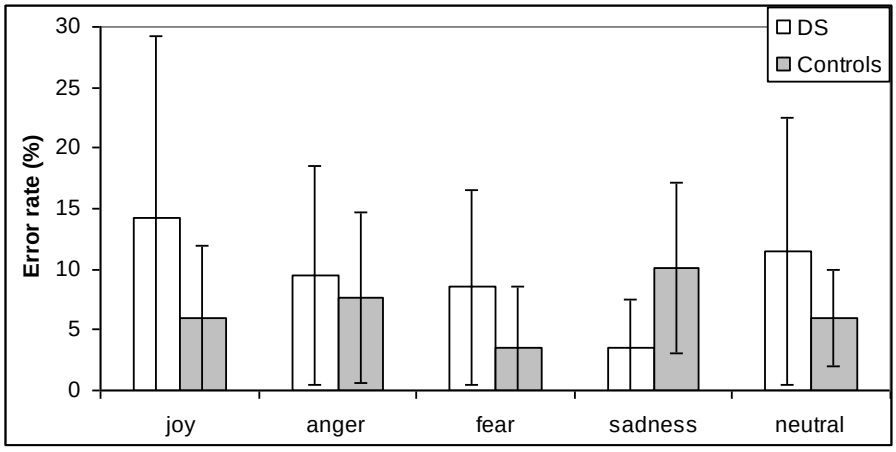

Figure 4. Mean percentage of error rate for the five expressions of the Emotion Attribution task for the two groups.

6.3 Correlations between the Emotion Attribution task, cognitive and facial expression processing measures, and CA

Pearson's correlations were run within the two groups to investigate the relationships between the Emotion Attribution task (separately per emotion), the cognitive measures, the expression tasks (global scores) presented in Experiment 1, and CA (see Table 5). The CA was again controlled for in the children's control group, and partial correlations are presented in parentheses in Table 5.

In the DS group, few significant correlations appeared between the specific cognitive competences and the Emotion Attribution task. The only relations we observed were between the selective attention measure and the score for anger and sadness. Neither the measures of receptive vocabulary nor nonverbal reasoning were related to the various expressions of the Emotion Attribution task in this group. Furthermore, few relations were found with the facial expression tasks. The sad expression alone was significantly correlated to the Expression Identification and Expression Matching tasks.

In the control group, few relations appeared with the cognitive measures and the Emotion Attribution task; the sad emotion alone was related to both selective attention measure and receptive vocabulary. In contrast to the DS group, no significant relations appeared with the facial expression tasks assessed in Experiment 1. Finally, we observed that CA was only related to the expression of anger.

Table 5. Correlations between the Emotion Attribution task, the Expression Identification and Expression Matching tasks, cognitive measures and CA in the DS and control groups

		Emotion Attribution Task			
Variables	Groups	Joy	Anger	Fear	Sadness
CA	DS	-.02	-.40	-.11	-.40
	Controls	.34	.41*	.29	-.003
EVIP-R	DS	-.01	.28	.41	.34
	Controls	.38 (.19)	.43* (.19)	.30 (.11)	.30 (.49*)
Nepsy Faces	DS	.29	.50*	.31	.65**
	Controls	.37 (.24)	.26 (.08)	.36 (.26)	.46* (.52**)
Expression Identification	DS	.17	.31	.13	.47*
	Controls	.04 (-.12)	.40 (.27)	.13 (.01)	.18 (.19)
Expression Matching	DS	.14	.23	.11	.75**
	Controls	.34 (.16)	.26 (-.01)	.11 (-.11)	.23 (.31)
Facial Discrimination	DS	.25	.13	.16	.29
	Controls	.03 (-.07)	-.15 (-.31)	.06 (-.03)	.30 (.31)
CPM Raven	DS	.20	.32	.31	.41
	Controls	/	/	/	/

Note. Partial correlations controlling for CA in the control group are shown in parentheses.
*p < .05. **p < .01.

7 Discussion

In this second experiment, the DS adults were proposed a new task designed to investigate their ability to attribute a facial emotional expression according to a context. The emotions of joy, sadness, anger, and fear were assessed while the neutral expression was used as a distracter. The main results showed that the DS adults only differed from their control group in the attribution of the item of sadness, for which they obtained poorer performances. Their attribution of this expression was worse than the other three, while no significant differences appeared between the expressions of joy, anger, and fear. The control group performed similarly for the various expressions, except for fear for which the attribution was

poorer than that for the expression of joy. The analysis of the error pattern showed that all participants rarely selected an emotion in the opposite hedonic tone (e.g., joy for anger). However, this was not true in the DS group for the sad expression, for which the emotion of joy was preferentially substituted. Furthermore, the DS adults rarely proposed this expression throughout the task, and the error rate for sadness was smaller than for any other expressions. Finally, the correlational analyses showed few significant relations between the Emotion Attribution task and cognitive competences or facial expression processing skills. We however observed that the emotion of sadness was related to the selective attention measure in both groups, as well as with the Expression Identification and Expression Matching tasks in the DS group.

8 General Discussion

In this study, we investigated facial expression processing and the ability to attribute an emotion to a context in adults with DS through two experiments. In Experiment 1, the capacity to process facially expressed emotions was examined following Hippolyte et al.'s (2008) previous work. Modifications were introduced to their experimental procedure to enhance the task sensitivity by increasing the number of items and distracters. In addition, new items were presented for the neutral expression. In Experiment 2, the ability to attribute a facial emotional expression to a social context was assessed through a new task specifically created for people with ID. The relationships between results on these experimental tasks and cognitive measures were explored in order to better understand the abilities involved in emotional processing.

In Experiment 1, we first observed that the DS group accomplished the Identity Matching test controlling for basic face processing skills as well as the control group. Of interest, the DS participants maintained a good performance in the first two subtests (complete faces similar and dissimilar), even though the difficulty level had been increased by adding a second distracter to the Bruce et al.'s original version (2000). Both groups performed poorly on the last three subtests in which some features (ears, hair, eyes) were concealed. These results replicated Hippolyte et al.'s findings and corroborated previous research on DS children (Williams et al., 2005; Wishart et al., 2007; Wishart & Pitcairn, 2000). Furthermore, our results strengthen the hypothesis that DS individuals can successfully perform facial tasks when no emotional demand is introduced. Concerning the facial expression tasks, the DS group generally performed well on the identification task, but their results were significantly

poorer than those of their controls for all expressions except sadness. These results differed from those obtained by Hippolyte et al., as the DS group performed the emotion of joy and anger as well as their controls in that study. These differences might be explained by the increased level of difficulty in the new version of the task (the addition of a second distracter), as well as by the control group's performances which were almost at the ceiling for these two emotions. In relation to the neutral expression, intra-group analyses showed that the DS participants identified it worse than all the other expressions. Theses results strengthen the assumption that DS adults have a particular impairment to processing neutral expressions.

Similarly to Hippolyte et al.'s previous results, the Expression Matching task in our experiment was completed with great difficulty by the DS adults. Yet the analyses conducted separately per emotion revealed that the DS participants processed the emotion of joy better than the other expressions. The authors suggested that the DS group's failure might be due to a bad comprehension of the task instructions, but we found in our study that most of the DS participants did the trial item (emotion of joy) well. We may rather relate their poor performances to the cognitive demands of the task, for which the level of difficulty was, in our view, higher than the other two expression tasks (identification and recognition). To successfully complete it, participants first had to define the emotion of the target face and then had to recognize it in another face. Considering the DS group's significant failure in this task, it might be more interesting to propose an easier version in subsequent studies. For instance, some studies with DS children (e.g., Williams et al., 2005; Wishart et al., 2007) have successfully administered a matching task in which the emotion of the target face was orally named by the experimenter. This procedure could easily be transferred to our task.

In the Facial Discrimination task, the results observed in the DS group corroborated Hippolyte et al.'s main findings, with a specific difficulty to rate the neutral faces and a tendency to assess expressions as being more positive than they actually were. Interestingly, the strong relation observed by Hippolyte et al. between the neutral expression and the EVIP-R score was replicated as well. These findings sustained the assumption that there is a particular link between the ability to recognize the neutral expression and the receptive vocabulary level in DS adults. We might thus advance that the recognition of the neutral expression in this task is hindered in the DS group by difficulties to understand its conceptual representation. However, our experimental design did not allow for further investigation of this hypothesis. The meaning and the interpretation people with DS attribute to a neutral expression should be explored in subsequent research.

More generally, the correlational analyses pursued between the facial expression tasks and the cognitive competences stressed the positive impact of the receptive vocabulary in the success of these tasks in the DS group. These results contrasted with findings from previous research in DS children (Williams et al., 2005; Wishart et al., 2007), in which no correlation appeared between language ability and performance in the emotional tasks. However, these studies conducted analyses on the task global score and not separately per emotion, which might have hidden relations. In our study, not all facial expressions were related to the receptive vocabulary measure.

Regarding the results of the Emotion Attribution task proposed in Experiment 2, the main findings showed that the DS adults only differed from the control group in the attribution of the sad emotion, for which they obtained poorer performances. Of interest, it was found in Experiment 1 that they generally processed this expression as well as their controls, suggesting that there is, in this group, a dissociation between the ability to process the emotion of sadness and to attribute it to a social context. The analysis of the DS adults' response pattern stressed a tendency to preferentially attribute the emotion of joy for the sad items. Such confusion was also remarked in the control group, but to a lesser extent. A part of these errors might be related to an observation we made during the assessment. We noticed that several participants did not focus their attention on the pertinent element of the drawing raising the emotion. For instance a participant might not spot the wounded bird lying on the ground in front of Marco (but rather the little flowers on the side), and considered him happy in this situation (to be seated in a meadow in flower). This hypothesis may be sustained by the significant positive correlations observed between these items and the selective attention task in both groups; participants might have particular difficulties to engage attentional resources on the negative element of the item.

In addition, we found positive relations between the score for the items of sadness and the Expression Matching and Expression Identification tasks in the DS group, showing that participants who were better at processing facial expressions obtained a higher attribution score for this emotion. We noticed that the DS adults did not only poorly perform on the items of sadness, but they also rarely attributed this expression throughout the task. This was confirmed by their error rate for sadness which was significantly lower than for any other expressions. We might thus suggest that the DS group tended to deliberately avoid the attribution of this emotion. Of interest, this tendency was specific to the sad emotion and did not apply to the other negative emotions. These results contrasted with the error pattern found by Kasari et al. (2001) and Porter et al. (2007) in DS children, as they observed that these

children tended to confuse various negative emotions (anger, fear or sadness) as positive ones. Furthermore, the DS group did not show a particular strength in attributing the emotion of joy, or a tendency to more frequently propose this emotion through the task. These findings also contrasted with results found in Experiment 1, in which the DS adults showed strengths in processing this emotion as well as a tendency to assess facial expressions as being more positive than they actually were.

Another interesting result concerns the relatively good performance found in the DS group for the fear expression. These findings might be surprising considering the results previously reported in the literature; most studies investigating this expression in DS children observed particular deficit in its recognition (Kasari et al., 2001; Williams et al., 2005; Wishart et al., 2007; Wishart & Pitcairn, 2000) and attribution (Kasari et al., 2001). Furthermore, the developmental literature shows that fear is recognized later (around 6 years) than other basic emotions (e.g., joy, sadness, or anger) (Bullock & Russell, 1986). In this experiment, we did not find any relation between the success rate for the fear expression and specific cognitive competences or emotion processing abilities. The DS adults' performances could be related to their own life experience. This emotion is frequently discussed in DS people's daily life. Caregivers and families regularly warn them about situations which might be dangerous (e.g., talking to strangers, compliance with others' demands, etc). To check this assumption, it would be interesting to examine other adult populations with ID and see if they also present a stronger attribution of this emotion. In addition, in the present study we did not control the processing of the facial emotion of fear. This emotion was not assessed in Experiment 1, which might be stressed as a limitation. It would be important to add this expression to the experimental tasks for subsequent studies, and see whether or not DS participants showed a dissociation between their abilities to process and attribute the fear expression.

Contrary to our expectations, only a few significant relations were found between the Emotion Attribution task and expression processing skills in both groups, suggesting an absence of direct relations between these two aspects of emotional competences. These findings might be explained by the greater complexity of the attribution task; if the ability to recognize facial emotions to be attributed constitutes a prerequisite to solve this task, it involves the ability to infer others' emotional state. Furthermore, few relations appeared between the Emotion Attribution task and the specific cognitive competences, thus corroborating studies in DS children which show no relation between their attribution task and mental age (Wishart & Pitcairn, 2000; Kasari, Freeman, & Hughes, 2001) or verbal age

(Turk & Cornish, 1998). Our task design which reduced the implication of verbal skills to a maximum, could explain the lack of correlations with the receptive vocabulary measure. Moreover, it is also possible that more complex language measures (e.g., syntactic comprehension) would show relations. The importance of language abilities in the success of tasks related to the theory of mind has been stressed in several studies conducted in populations with ID (diverse aetiologies) (e.g., Abbeduto, Short-Meyerson, Benson, & Dolish, 2004; Charman & Campbell, 2002; Thirion-Marissiaux & Nader-Grosbois, 2008b).

Important variations were observed in the DS group's results according to the task modalities. These findings showed the impact that a particular emotional task might have on the participants' performances and stressed the relevance to assess these abilities with several tasks. Despite these result variations, the different tasks proposed in this study allowed specificities in the DS adults' response pattern to be highlighted. Corroborating Hippolyte et al.'s findings, our results emphasized a general impairment in the processing of the neutral expression, as well as a tendency to overly positively judge facial expressions. The implications of this particular facial expression processing for other aspects related to the social and relational sphere would be interesting to explore in further research. In addition, the causes for the DS adults' impairment with the neutral expressions needs to be further investigated. In relation to the Emotion Attribution task, this new tool seemed to have the correct sensitivity to assess people with a moderate ID. Furthermore, it also allowed for a more qualitative approach through the possibility of analysing participants' response pattern. The tendency found in the DS group to avoid attribution of the sad emotion constitutes, in our view, a result of great interest, providing further information on the DS adults' emotion processing pattern. It would be important to see if further studies replicate this bias. Finally, the specificity of the DS adults' response pattern needs to be confirmed. The results of our study showed that the individuals with DS presented particularities in their response pattern in comparison to TD children. However, this study does not allow us to ascertain that this pattern is specific to DS in relation to other populations presenting a genetic disorder associated with ID. It would be important in the future to conduct comparative studies in order to investigate this issue.

ETUDE 3

A new emotional Stroop-like task: Application to the Down syndrome population[34]

Abstract

The present study proposed to test the applicability of a new emotional Stroop-like paradigm among 49 adults with Down syndrome (DS), matched with typically developing children on gender and receptive vocabulary. Stimuli with neutral and emotional content were presented in two identical computerized tasks. This experimental design allowed comparisons of inhibition performance according to the nature of the material. Main results showed that the DS group processed the emotional material more poorly than the control group in the inhibition condition, whereas all participants performed near or at ceiling in the control condition. Regarding the response latencies, both groups processed emotional material slower than the neutral material. The DS participants did not take more time to respond than their controls, but they presented a distinct response latency pattern during the task: While the control group kept their response times constant, the DS group showed an improvement during the task.

[34] This study is a reprint of the article: Hippolyte, L., Iglesias, K., & Barisnikov, K. (2009). A new emotional Stroop-like task: Application to the Down syndrome population. *Archives of Clinical Neuropsychology*, *24,* 293-300.

1 Introduction

The emotional Stroop is a paradigm widely-used for investigating aspects of emotion processing through an inhibition measure (Amir, Freshman, & Foa, 2002; Perez-Edgar & Fox, 2003; J. Williams, Mark, Watts, MacLeod, & Mathews, 1997). Adapted from the classical Stroop Interference Test (Stroop, 1935), participants are asked to name the colour of neutral and emotional words. The choice of emotional words is usually related to applicability in a specific clinical population (e.g., hairy and crawl for spider phobics, Watts, McKenna, Sharrock, & Trezise, 1986). It has been observed that the colour-naming of emotional words is slower compared to neutral words in clinical groups only.

The classical Stroop test—as well as its emotional adaptation—require reading abilities, and alternative versions have been designed. One of them is the Stroop-like paradigm, which has been originally developed for young, pre-reading children. The "Day-Night" task is one of these notable extensions (Gerstadt et al., 1994). This task assesses the ability to inhibit a predominant response, such that participants are asked to respond "day" to a night-time picture and "night" to a daytime picture. However, similarities between the Stroop test and the Day-Night task have been questioned by some authors. For Wright, Waterman, Prescott, and Muroch-Eaton (2003), Stroop-like versions that present more stimuli, such as the fruit Stroop (Archibald & Kerns, 1999) or the animal Stroop (Wright et al., 2003), are closer to the classical Stroop test and more accurate for measuring inhibition abilities. Yet these tasks are difficult to administer to participants under the age of 7 as they contain complex stimuli and instructions.

Despite critiques, the Day-Night task remains a tool of choice for assessing inhibition abilities in young children (e.g., Carlson & Moses, 2001; Roebers & Schneider, 2005; Wolfe & Bell, 2007), and several adaptations have been developed (Archibald & Kerns, 1999; Beveridge, Jarrold, & Pettit, 2002; Simpson & Riggs, 2005). In addition, this task seems to be well-suited to children and adults with intellectual disability (ID) (Atkinson et al., 2003; Tager-Flusberg, Sullivan, & Boshart, 1997; Walley & Donaldson, 2005). Of note is that all Stroop-like tasks mentioned above have used pictorial stimuli with no emotional meaning and can, therefore, be considered as counterparts of the classical Stroop. To the best of our knowledge, no emotional equivalent has yet been developed.

There are, on the other hand, many pictorial emotional Stroop versions which present emotional pictures instead of words (e.g., Constantine, McNally, & Hornig, 2001; Kindt &

Brosschot, 1997; Mazurski, Bond, Siddle, & Lovibond, 1996). These pictorial tasks present an interesting non-lexical alternative for measuring inhibition abilities with emotional material. This paradigm would likely be appropriate for studying populations known for their atypical manner of processing emotional information, such as people with Down syndrome (DS; Hippolyte et al., 2008), Williams syndrome (Gagliardi et al., 2003), or fragile X (Turk & Cornish, 1998). Persons with DS are characterized as being cheerful, and as actively seeking social contact (Dykens et al., 1994). It has been hypothesized that DS individuals might exhibit strength when processing emotions (Kasari et al., 2001). However, most studies in DS children have shown impairments, with specific difficulties in recognition of negative expressions such as anger and fear (Kasari et al., 2001; K. Williams et al., 2005). Hippolyte et al. found that DS adults presented a positive bias when judging facial expressions and intensity of emotional expressions. Despite their ability to recognize positive and negative emotions, such as joy and sadness, they had a tendency to assess expressions as being more positive than they actually were. Furthermore, correlational analyses showed that this bias was strongly and negatively related to the Day-Night task.

The main objective of the present study is to propose an emotional Stroop-like paradigm adapted to assess people with mild and moderate ID. Relying on the assumption that emotional material is processed differently, depending on the value attributed to it, we wanted to examine inhibition abilities of DS individuals presented with emotional versus neutral material. The existing pictorial emotional Stroop tasks are too difficult for people with ID. The complex instructions and the large number of stimuli presented require important cognitive, attentional and working memory resources. Therefore we constructed two equivalent Stroop-like tasks, varying only the nature of their stimuli (emotional and neutral), and each containing two conditions: a control condition (name what is shown on the screen) and an inhibition condition (name the opposite of what is shown on the screen). Regarding the neutral material, we used the "Sun-Moon" task (Archibald & Kerns, 1999), an adapted version of the Day-Night task designed to obtain a lower ceiling effect. Concerning emotional material, we created the "Happy-Sad" task, the stimuli for which consisted of a child displaying a happy versus a sad facial expression. Results for the DS adults were compared to those of typically developing children matched on receptive vocabulary. This matching measure seemed relevant, since the administration of the experimental tasks requires a minimum level of verbal knowledge (i.e., instruction comprehension) and verbal responses. This comparative approach allowed us to identify whether the DS adults' performance in the Stroop-like tasks was impaired or not in terms of a quantitative score difference (e.g.,

presence of developmental delay). Additionally, potential atypical processing could also be revealed by qualitative differences between the groups' patterns of performance.

The following hypotheses were proposed; With regard to the control condition, we did not expect an effect of material type on success rates for either group. As reported in the literature, faces and emotions are processed as prominent stimuli, and could be more difficult to inhibit than neutral stimuli. We therefore predicted lower success scores for emotional material for both groups in the inhibition condition. In relation to the particular emotional pattern observed in the DS population, we also expected that our DS group would err more than their matched controls in the "Happy-Sad" task, whereas we did not have specific assumptions for the "Sun-Moon" task. Regarding response latencies, we expected slower response times for both groups when processing emotional as opposed to neutral material, as reflected in the literature. We further assumed that the DS group would be slower than their controls when processing emotional material, since faces represent a highly captivating stimulus for them.

2 Method

2.1 Participants

Forty-nine participants with DS took part in the study (31 men, 18 women), all with a moderate ID. All participants had a medical diagnosis of Trisomy 21 and were recruited from two sheltered workshops. Significant sensory, psychiatric or physical disabilities, as well as clinical symptoms of dementia, constituted exclusion criteria for participation. The mean age of this group was 33.78 years (SD = 9.00). Adults were individually matched on gender and on the raw score of a receptive vocabulary task with a control group comprised of typically developing children attending an elementary public school (mean age = 5.88, SD = 1.05). The vocabulary task was the French adaptation of the Peabody Picture Vocabulary Test-Revised (Dunn, Thériault-Whalen, & Dunn, 1993). On this task, the DS group obtained a mean raw score of 67.28 (SD = 25.13) and the control group had a mean score of 68.24 (SD = 24.96). This difference was not statistically significant, $t(96) = -.19$, $p = .85$. These scores corresponded to a developmental verbal age of 6.27 years for the DS and of 6.34 years for the control group. In addition, productive vocabulary ability (frequent words) was assessed with a subtest taken from the French Isadyle Battery (Piérart, Comblain, Grégoire, & Mousty, 2007) in order to check for its potential influence on the experimental tasks. The DS group obtained

a mean percentage score of 83.42 (*SD* = 10.40), and the control group had a mean score of 82.26 (*SD* = 11.72). These scores were not statistically different, $t(96) = .52$, $p = .605$.

2.2 Apparatus and stimuli

The experiments were conducted on a laptop running E-Prime-1.0 (Schneider, Eschman, & Zuccolotto, 2002). Stimuli were randomly displayed one at a time and the software recorded response latencies per stimulus. Participant responses were recorded directly by the experimenter using the computer. Vocal responses registered by the computer had to be ruled out due to pronunciation and speech difficulties frequently encountered in the DS population. Similarly, in order to prevent disadvantage of the participants having motor difficulties, a key-press response time was not used. In addition, this type of responding adds the memory load of remembering which buttons to press, which might have interfered with the tasks. Once the response was triggered, the experimenter pressed one of the two mouse buttons to stop the time. The response was then coded as correct (left button) or incorrect (right button). The response items used in both tasks (*soleil*, *lune, content,* and *triste*) had a high mean lexical frequency (M = 27.670; range = 16.423-45.939; database intended for children of primary school, Lambert & Chesnet, 2001).

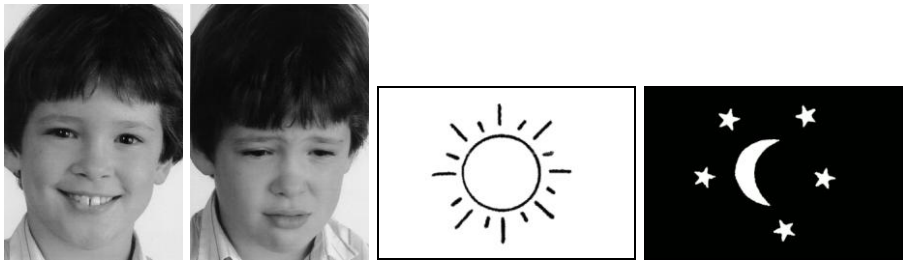

Figure 1. Stimuli used in the "Happy-Sad" and "Sun-Moon" tasks

The stimuli were presented in black-and-white (see Figure 1). For the "Sun-Moon" task, we used the original stimuli from Gerstadt et al.'s study (575 × 383 pixels). The stimuli of the "Happy-Sad" task (2 faces; 400 × 575 pixels) were adapted from a set of facial pictures belonging to a children's game (*Jeux de visages,* Editions Nathan). This game contains photographs of a boy and a girl displaying various emotions. In order to select the experimental stimuli, the photographs displaying expressions of joy and sadness were first shown to five experts at the Facial Action Coding System (Ekman & Friesen, 1978) at Geneva University. They were asked, in an open-ended fashion, to name the emotion which they thought best described each photograph. Joy and sadness were recognized by all experts for the boy's pictures. For the girl's picture, joy was accurately recognized, but sadness was

identified as sulk by four experts. The same pictures were then shown to 22 adults (11 women; mean age = 30.64, *SD*= 6.17) and 26 children (13 girls; mean age = 6.19, *SD*= 0.8) using the same procedure. The expression of joy was accurately identified by both groups for the two photographs. The expression of sadness for the boy's picture was recognized as such by 96% of the children and 87% of the adults. The girl's picture was recognized as sad by 65% of children and only 18% of adults. Given these results, we selected the boy's pictures. While it is generally recognized that pictures of men displaying an angry expression are perceived as more threatening than women's pictures (Mazurski et al., 1996), there is to our knowledge no corresponding assumption for the expression of sadness.

2.3 Procedure

All participants were tested individually by a trained clinical psychologist in a quiet room at their workplace or at school. The Stroop-like tasks were administered separately in two sessions approximately two weeks apart, and their order was counterbalanced. Each experimental task was composed of three events: (1) a black central fixation cross for 1000 ms, (2) the stimulus displayed on a white background, and (3) a blank white screen (duration 1000 ms). Each stimulus remained until the response was given. Participants were asked to respond as quickly as possible while avoiding mistakes. The assessment always began with the control condition, where participants were instructed to state what was being shown on the screen. This allowed us to monitor comprehension of the basic instructions and to measure basic processing speed. This condition was followed directly by the inhibition condition, in which participants were instructed to state the opposite of what was being shown on the screen. Each condition had 24 items equally distributed among the two stimuli. Two success rate scores and two reaction times scores were calculated for each task. Training trials with response-appropriate feedback were administered at the beginning of each condition to ensure its comprehension. Testing did not begin until these trials yielded accurate responses, and a limit of three attempts was set to avoid learning effects. In the "Happy-Sad" control condition, participants were instructed to respond with "happy" when shown the smiling child's picture, and to respond with "sad" to the sad child's picture. At the end of the presentation of the 24 items, a blank screen with the sentence *"change of task"* appeared, and the experimenter then explained the rules for the inhibition condition. Participant were instructed to respond "happy" to the picture of the sad child's picture, and "sad" to the smiling child's picture. The procedure for the "Sun-Moon" task was strictly equivalent.

3 Results

3.1 Analysis of the number of successes

In order to control comprehension of neutral and emotional material, the number of successes in the control condition was first considered. The success rates were equivalent in the DS and control groups for both tasks (percentage between 95.3 and 98.3 for both groups). The number of successes in the inhibition condition was then analyzed, resulting in a success rate that was contingent upon the group and the stimulus material. Consequently, our subsequent statistical analyses took into account this score for the inhibition condition only. A generalized linear mixed model (McCulloch & Searle, 2001), with group and presentation order as between subject factors and material (neutral versus emotional) as the repeated measures factor, was conducted on the number of correct responses. The use of a regular ANOVA with repeated measures was not possible due to the nature of the scores (a sum of successes following a binomial distribution), and also because the assumptions of the ANOVA were violated.

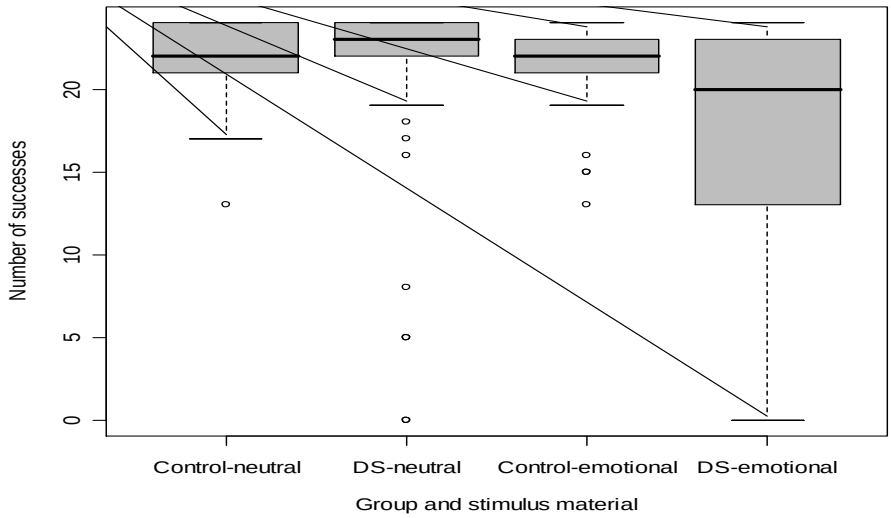

Figure 2. Distribution of the number of successes by group and stimulus material

The analysis revealed that there was a significant main effect of material, z = -8.79, p<.001, indicating that the probability of success was lower for emotional as compared to neutral material. The presence of a significant interaction between material and group (z = -6.70, p<.001) was observed, showing that the DS group performed worse with the emotional material than the control group (see Figure 2). There was no significant main effect of presentation order, but there was a significant interaction between the presentation order and

stimulus material, $z = 3.16$, $p<.01$. An improvement of all participants throughout the task was observed, but only when assessment began with the emotional material.

Finally, we examined the potential influence of the two emotional stimuli on the number of successes in the emotional task. We estimated a generalized linear mixed model using a binomial distribution, with group as the between-subjects factor and material (Sad versus Happy) and condition as the repeated-measures factor (control versus inhibition) on the number of successes. There was no effect of group or material, indicating that both groups processed the "sad" and "happy" items indiscriminately.

3.2 Response time analysis

Preliminary analyses showed that the distribution of latency scores did not vary by response accuracy for the two groups; thus, we carried on the analyses taking into account all response times. We first calculated the median of the 24 measures of response time for each participant. The median was chosen in order to minimize the effect of extreme values. A mixed ANOVA, with group and presentation order as between-subjects factors and material and condition as repeated-measures factors, was conducted on the logarithm of the median response times. The logarithm was chosen in order to normalize the response time distribution. The analyses revealed two significant main effects: material, $F(1,91) = 26.39$, $p<.001$; and condition, $F(1,91) = 306.09$, $p<.001$. There was also a significant interaction between material and condition, $F(1,91) = 4.94$, $p<.05$. It took more time to process emotional than neutral material for both DS and control groups. Contrary to our expectations, there was no main effect or interaction of group. The DS participants did not take more time to respond than controls.

Second, we were interested in investigating if a learning process might emerge throughout testing. To explore this possibility, we divided the 24 response time measures into three separate periods: the median times for the items 1 to 8; 9 to 16; and 17 to 24. An ANOVA, with group and presentation order as the between-subject factors and material, condition and period ("item 1 to 8" versus "item 9 to 16" versus "item 17 to 24") as repeated-measures factors, was conducted on the logarithm of the median response times. As before, there was a main effect of material, $F(1,90) = 25.05$, $p<.001$, and a main effect of condition, $F(1,90) = 295.67$, $p<.001$. The interaction between material and condition was also significant, $F(1,90) = 8.94$, $p<.01$. Of interest was the presence of a significant interaction between time and group, $F(1,180) = 9.43$, $p<.001$. Whereas the control group response times

were constant through the task, the DS group improved their median response times during the second period of assessment.

Finally, we tested the difference in response times between the "Sad" and the "Happy" stimuli. We conducted an ANOVA on the logarithm of the median response times for each of the 12 "Happy" and "Sad" stimuli, with group as the between-subjects factor and material (Sad versus Happy) and condition (control versus inhibition) as the repeated-measures factors. We found only a significant main effect of condition, $F(1,91) = 161.00$, $p<.001$, indicating that the mean response times for the inhibition condition were higher than the control condition.

4 Discussion

The first goal of the present study was to develop and test a new emotional Stroop-like task adapted to assess inhibition abilities in people presenting ID. Our second goal was to compare participant performance when inhibiting emotional versus neutral stimuli. To achieve this purpose, two identical tasks varying only on the nature of the stimuli were proposed: the "Happy-Sad" task (emotional material), and the "Sun-Moon" task (neutral material). These tasks were administered to an adult population with DS and a control group matched on receptive vocabulary level. One of the major findings of this study is that DS participants exhibited greater difficulty inhibiting a prepotent response to emotional stimuli. The specificity of this impairment may be supported on two grounds. First, the results obtained in the control conditions showed a good understanding of the two kinds of stimuli per se by all participants. Second, DS participants' results varied in the inhibition condition depending on the material presented. Whereas they performed with the neutral material as well as their controls, their performance was worse with the emotional material. This difficulty in inhibiting a prepotent response to stimuli with emotional content can be considered specific to the DS group, since the control group's performance did not depend on the nature of the material.

This impairment might be associated with the DS participants' difficulties to process emotions (Hippolyte et al., 2008; Kasari et al., 2001; Turk & Cornish, 1998). In addition, it has been shown that facial stimuli generally require more attentional resources to be processed (Verbruggen & De Houwer, 2007), and engage additional cognitive abilities (e.g., face recognition, emotion perception) as compared to stimuli with neutral content (Schulz et al., 2007). In our study, we did not observe these difficulties in the control group, but they

were possibly masked by a ceiling effect of the task. Thus, the DS group's larger error rates in the "Happy-Sad" task might be related to the increased cognitive demand of its stimuli. Moreover, the literature pointed out that the DS adults judged facial emotions as being more positive than they were (Hippolyte et al., 2008). This positive bias presented by DS adults was negatively related to the Day-Night task, showing that participants who assessed emotions as being more positive also displayed lower performance in this task.

This finding suggests that the bias could be related to an impulsive behaviour, such that participants might have been unable to repress an overly-positive judgment of the stimuli. According to the particular emotional pattern found in the literature, we may assume that our DS participants would have more difficulty inhibiting the "happy" than the "sad" items in the emotional task. These results would be in accordance with Schulz et al. (2007), who showed that healthy adults committed more errors inhibiting happy facial expressions than sad ones in a go/no-go paradigm. However, our results showed no differences in the DS group's error rate according to item. These results might be related to the nature of the positive bias found by Hippolyte et al. (2008). In that study, the bias did not rely exclusively on an overstatement for the expression of joy, but was also associated to the expression of sadness, perceived as less intense. DS adults were thus biased in their judgment of both positive and negative emotions.

Relating to response times, main results showed that both groups were slower in processing emotional material. This finding is consistent with previous studies using emotional Stroop paradigms, as well as with the idea that facial stimuli require more time to be processed than non-emotional stimuli (Schulz et al., 2007). It seems that facial stimuli induce an interference effect which could be interpreted as an attentional bias (J. Williams, Mathews, & MacLeod, 1996). In our study, this attentional bias towards emotional stimuli was found in both control and inhibition conditions, suggesting a general attention-capturing effect of these stimuli. The particularity of the emotional material might also be confirmed through the learning effect we observed. The analysis of the presentation order of the material showed that both groups improved their performance during the second assessment session, but only when beginning with the "Happy-Sad" task. Our results suggest that starting with emotional material helps to better process neutral material, but not the contrary. A transfer of competences might not take place as quickly for the facial stimuli as for the neutral ones, a finding which could be linked to the more salient value of facial cues (LeDoux, 1998; Verbruggen & De Houwer, 2007).

Contrary to our expectations, DS participants' response times were not significantly longer than those of their controls across any condition or material. This finding was

surprising, since the DS population usually shows slower basic processing speed in comparison with control groups (typically developing children or participants with ID matched on mental age; e.g., Nadel, 1999; Rowe et al., 2006). Our results might be explained by the fact that the experimenter registered participants' responses. Indeed, experimental procedures which require a motor response place individuals with DS at a disadvantage, as they frequently present difficulties with motor planning and praxis (Fidler, 2005; Mon-Williams et al., 2001). Nevertheless, they presented a dissimilar pattern throughout the task. Whereas the control group median response times remained constant, those for the DS group improved for both materials from the second period of assessment onwards. These findings suggest that DS individuals are able to display progress even when processing a difficult task, though these results must be qualified as they relate only to response times and not to score accuracies. However, this improvement indicates an interesting learning potential in this group. Of importance, the error terms were spread across the tasks, showing that DS participants reduced their response times without impact on score accuracy. The response time constancy observed in the control group might be explained by the fact that the task was easy for them and required relatively few cognitive resources. Therefore, children may have performed at best from the start, and maintained a stable performance throughout the task.

Finally, we were interested in investigating whether or not response times would differ between happy and sad stimuli in the inhibition condition. Previous studies have shown that happy faces are processed faster than sad ones (Grimshaw, Bulman-Fleming, & Ngo, 2004; Leppanen & Hietanen, 2004), a finding that was also observed in inhibition conditions in a go/no-go paradigm (Schulz et al. 2007). However, we did not find any significant differences for both groups in this study, which corresponded to the observations we made for the success rate scores.

Our results showed the utility of an emotional Stroop-like paradigm for studying population with ID. The tasks we proposed furnish an interesting tool for investigating inhibition capacities for emotional and neutral material, as well as emotion processing indirectly. The measures we obtained showed a good sensitivity to the task with the DS participants, but this paradigm would also have utility among pre-school children and other clinical populations with a particular socio-emotional profile, such as Williams syndrome, X-fragile, or individuals with Autism and ID. Nevertheless, some limitations of our study must be addressed. Our results showed that DS participants presented an atypical response pattern in comparison to typically developing children. However this study does not allow for the assertion that this pattern is specific to DS in relation to other populations presenting a genetic

disorder associated with ID. Comparative studies will be necessary to investigate this issue. Another limit concerns the restriction of the paradigm according to the population assessed. The task demand is simple and might quickly reach ceiling in populations with higher cognitive abilities. As our stimuli consist of only two pictures per task, their level of difficulty might be increased by augmenting the number of emotional targets proposed (happy and sad expressions represented by different faces). In order to further investigate the specific impairment observed with the facial emotional stimuli, it would also be important to introduce other expressions such as angry or neutral faces. These studies could help us better to understand the role of emotion in inhibition processing difficulties. In addition, the emotional facial stimuli used in this study refer to a particular aspect of emotion, related to social relations and behaviour. It would also be interesting to propose new versions introducing others types of emotional stimuli, for example stimuli related to self-control (e.g., food) to see if inhibition difficulties will take place under these conditions.

ETUDE 4

Social reasoning skills in adults with Down syndrome: The role of language, executive functions and socio-emotional behaviour[35,36]

Abstract

Background Although the prevalence of mental illness and behaviour problems is lower in adults with Down syndrome (DS) than in other populations with intellectual disabilities, they do present emotional and relational problems, as well as social integration difficulties. However, studies reporting on specific competences known to be central in developing appropriate social relationships (e.g., social reasoning, emotion processing, theory of mind) remain rare in the adult DS population and the mechanisms underlying these people's emotional and relational difficulties are unclear.

Method The present study investigated the ability to understand the appropriateness of others' social behaviour in 34 adults with DS, using the Social Reasoning Task (SRT). Their results were compared with those of 34 typically developing (TD) children matched for gender and receptive vocabulary. The relationships among the SRT experimental task, cognitive competences (receptive and productive vocabulary, non-verbal reasoning, inhibition, selective attention) and a caregiver-rated measure of socio-emotional behaviour were examined in the DS group.

Results The DS participants' global SRT scores did not differ from those of the controls. However, analyses of the SRT subscores revealed that the DS group identified significantly fewer inappropriate situations than the control group. Nevertheless, when they correctly identified the behaviour as inappropriate, they were as well as the controls to explain the rules underlying their responses. Regression analyses showed that receptive vocabulary and

[35] Hippolyte, L., Iglesias, K., Van der Linden, M., & Barisnikov, K. . Social reasoning skills in adults with Down syndrome: The role of language, executive functions and socio-emotional behaviour. *Journal of Intellectual Disability Research*.

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selective attention and a specific dimension of the socio-emotional profile (social relating skills) constituted the best predictors of the DS adults' performance on the SRT.

Conclusions The main findings show that the DS participants demonstrate relatively good social reasoning skills in comparison to TD children matched for verbal age. However, the two groups present distinctions in their response patterns, and the influence of cognitive variables on success on the SRT also appears different. While selective attention skills are found to be significant predictors for both groups, the influence of receptive vocabulary level is much stronger in the DS group. The implications of particular cognitive and socio-emotional factors for success on the SRT in this group are considered in more detail.

1 Introduction

Research conducted on socio-emotional abilities in people with Down syndrome (DS), and specifically in adults, remains surprisingly rare when one considers the number of people affected by this syndrome. DS is the most common genetic form of intellectual disability (ID), and the adult population is largely represented in sheltered workshops and specialized institutions. For a long time, people with DS have been characterized as presenting good socio-emotional skills and few social behavioural problems (Carr, 1995; Dykens et al., 1994; P. Gunn & Cuskelly, 1991). Furthermore, studies reporting on mental illness and behaviour problems in adults with ID show a lower prevalence in people with DS. Antisocial, aggressive or destructive behaviour remains relatively low in this population compared to other adults with ID (Cooper et al., 2009; Mantry et al., 2008; Melville et al., 2008).

Yet, studies in DS people have also emphasized emotional and relational problems such as oppositional behaviour, intrusive behaviour and stubbornness (Coe et al., 1999; Fidler et al., 2008). Social integration difficulties have been underscored in young DS adults, who have been found to show particular problems developing a social network and maintaining friendships (Soresi & Nota, 2000). Furthermore, adults with DS present difficulties with specific competences known to be central to the development of appropriate social relationships, such as emotion processing (Hippolyte et al., 2008; Hippolyte, Barisnikov et al., 2009) and abilities related to theory of mind (Abbeduto et al., 2001; Zelazo, Burack et al., 1996). To date, very little work has investigated these competences in DS adults and the mechanisms underlying these people's emotional and relational difficulties.

The present study aims to explore another aspect of socio-emotional competences: the ability to understand the appropriateness of other people's social behaviour. While this ability has been extensively investigated in TD children (e.g., Nucci & Turiel, 1978; Turiel, 1983; Zelazo, Helwig, & Lau, 1996), few studies have been conducted in populations with neurodevelopmental disorders. We found only two studies exploring this ability in children with autism (Grant, Boucher, Riggs, & Grayson, 2005; Loveland et al., 2001), whereas, to the best of our knowledge, these skills have never been investigated in adults with DS. In the DS population, social understanding has essentially been considered through questionnaires (Hawkins et al., 2003; Loveland & Kelley, 1988; Rosner, Hodapp, Fidler, Sagun, & Dykens, 2004), which might be explained by the difficulty of finding suitable tasks for this population.

In our view, it would be interesting to develop a task adapted to DS participants, in order to assess their competences by a direct measure.

In the present study, we proposed to examine the social reasoning skills of adults with DS by using the Social Resolution Task (SRT), which was specifically created for people with mild to moderate ID. This task presents drawings illustrating social situations that are either appropriate or not, based on knowledge of conventional and moral rules. Its instructions are short and simple to avoid information processing overload. The DS adults' results on the SRT were compared with those of TD children matched for their receptive vocabulary abilities. We chose this match to check for differences in verbal ability that might interfere with the SRT. Furthermore, it constitutes a measure frequently used in studies reporting on social reasoning skills in people with ID (e.g., Bieberich & Morgan, 2004; Gomez & Hazeldine, 1996; Grant et al., 2005).

The general cognitive processes related to socio-emotional competences and theory of mind skills have been examined by several studies of people with ID. The involvement of language skills has been emphasized in numerous studies (Abbeduto & Murphy, 2004; Frith et al., 1994; Thirion-Marissiaux & Nader-Grosbois, 2008a). In addition, executive functions such as inhibitory control, attentional processing and working memory have been shown to play a significant role in the success of these socio-emotional tasks in populations of TD children (Carlson, Moses, & Breton, 2002; Flynn et al., 2004; Gordon & Olson, 1998; Rhoades et al., 2009) and in clinical populations involving children with autism spectrum disorders (Ames & Jarrold, 2007; Joseph & Tager-Flusberg, 2004), fragile X (Grant et al., 2007) and traumatic brain injury (Henry, Phillips, Crawford, Ietswaart, & Summers, 2006).

The potential impact that cognitive skills might have on the DS group's performance on the SRT was investigated in this study. For this purpose, general cognitive processes reported to be related to socio-emotional tasks in the developmental and clinical literature were considered. We included measures of productive vocabulary, non-verbal reasoning, inhibition of a prepotent response (verbal and motor) and visual selective attention. Selective attention was also assessed in the children in the control group, as these skills may play a critical role in the processing of the SRT drawings.

Finally, we were interested in exploring the potential relations between the SRT and a caregiver-rated measure of DS adults' socio-emotional behaviour. Indeed, we postulate that participants who were best able to judge the appropriateness of others' behaviour in the SRT task would also present better social competences. Studies involving TD children generally found associations between poor social reasoning skills and aggressiveness (for a literature

review, see Harvey, Fletcher, & French, 2001). Basquill, Nezu, Nezu, and Klein (2004) also observed such relations in adult males with mild ID (aetiology non-specified). However, the studies investigating these links in the population with ID remain rare, and there are no studies in DS people.

2 Materials and methods

2.1 Participants

Thirty-four participants with DS (12 of whom were women) who had a moderate ID took part in the study. They were recruited from two sheltered workshops. All participants had a medical diagnosis of Trisomy 21 and had attended special schools for people with ID. Significant sensory, psychiatric or physical disabilities, as well as clinical symptoms of dementia, constituted exclusion criteria for participation. The mean chronological age (CA) of the group was of 32.22 years (*SD* = 9.66). Adults were individually matched for gender and raw score on a receptive vocabulary task with a control group comprising TD children attending an elementary public school (mean CA = 5.69, *SD* = 1.63). The vocabulary task was the French adaptation of the Peabody Picture Vocabulary Test – Revised (Evip-R; L. Dunn et al., 1993). On this task, the DS group obtained a mean raw score of 65.85 (*SD* = 22.77) and the control group had a mean score of 66.59 (*SD* = 20.01). This difference was not statistically significant.

Two selective attention subtests (Rabbits and Faces) taken from the Nepsy neuropsychological battery (Korkman et al., 2003) were administered to all participants[37] (see Table 1). In the Rabbits subtest, participants were asked to search for target pictures (rabbits) among dissimilar distracters (e.g., apple, tree, and dog). The Faces subtest was more complex as two targets (two specific faces) had to be found among similar distracters (other faces). The time was limited to 180 seconds for each subtest, and participants were instructed to proceed as quickly as possible. The DS group obtained a poorer precision score (number of hits minus false alarms) for the Faces subtest ($P = 0.001$), and took significantly more time to perform both subtests (Rabbits: $P < 0.001$, Faces: $P < 0.001$) than the TD children.

[37] Two young children in the control group could not be given the Faces subtest as they did not understand the task instructions.

Table 1. Participants' main characteristics

	DS group	Control group
Sample size (male / female)	34 (22 / 12)	34 (22 / 12)
Chronological age (years, mean ± SD)	32.22[a] (± 9.66)	5.69[b] (± 1.63)
Evip-R: developmental age (years, mean ± SD)	6.12 (± 1.95)	6.14 (± 1.7)
Rabbits subtest precision score[1] (mean ± SD)	17.91 (± 2.43)	18.74 (± 1.64)
Rabbits subtest response time (sec., mean ± SD)	133.32[c] (± 43.03)	79.97[d] (± 40.57)
Faces subtest precision score[1] (mean ± SD)	1.38[e] (± 5.88)	7.41[f] (± 8.26)
Faces subtest response time (sec., mean ± SD)	179.5[g] (± 2.58)	153.04[h] (± 40.99)

Note. [1] Maximum precision score = 20.
a > b, P <0.01; c > d, P <0.01; e > f, P <0.01; g > h, P <0.01

Additional cognitive tasks assessing non-verbal reasoning, productive vocabulary and inhibition skills were administered to the DS adults to check for their potential influence on the SRT. Non-verbal reasoning ability was assessed using Raven's Coloured Progressive Matrices (CPM; Raven et al., 1998): mean raw score = 15.09, *SD* = 5.31 (corresponding approximately to an IQ of 57). Productive vocabulary abilities were assessed with a naming subtest taken from the Isadyle French language battery (Piérart et al., 2007): mean percentage score = 70.34, *SD* = 11.72. Finally, two tasks requiring participants to inhibit a prepotent response were administered: the Sun-Moon task (verbal response) (computerized version; Hippolyte, Iglesias et al., 2009), which is adapted from the Day-Night Stroop-like task (Gerstadt et al., 1994) and the tapping task (motor response) (Diamond & Taylor, 1996; the number of items was increased from 16 to 24). The DS participants obtained a mean percentage score of 82.39 (*SD* = 30.99) in the Sun-Moon task and of 60.42 (*SD* = 35.67) in the tapping task.

Finally, the Developmental Behaviour Checklist[38] (DBC-A adult version, Einfeld & Tonge, 2002) assessing the emotional and behavioural problems of adults with ID was completed by the DS adults' referent caregivers (sheltered workshop). This checklist provided a global score as well as six subscale scores. The items are rated on a 3-point scale (0 = not true, 1 = somewhat or sometimes true, 2 = very true or often true) and mean scores can be calculated (continuum between 0 and 2). The DS group obtained a mean global score of 0.19 (*SD* = 0.16), and mean scores on the subscales were as follows: 0.25 (*SD* = 0.28) for subscale 1, Disruptive (e.g., tantrums, irritable); 0.08 (*SD* = 0.09) for subscale 2, Self-absorbed (e.g.,

[38] We used the French version of the DBC-A. The internal consistency of the 6 subscales was satisfactory (Cronbach's α between 0.8 and 0.9 for subscales 1 to 4 and 6; Cronbach's α of 0.72 for subscale 5).

bangs head, screams); 0.25 (*SD* = 0.22) for subscale 3, Communication disturbance (e.g., talks fast, hallucination); 0.08 (*SD* = 0.14) for subscale 4, Anxiety/Antisocial (e.g., hides things, steals); 0.42 (*SD* = 0.35) for subscale 5, Social relating (e.g., loner, shy); and 0.19 (*SD* = 0.25) for subscale 6, Depression (e.g., withdrawn, lost self-care).

2.2 Procedure

All participants were tested individually in a quiet room at their workplace or at school. The TD children in the control group completed the SRT and the cognitive tests (Nepsy and Evip-R) in one session (25 to 35 minutes). Two to three sessions were necessary (25 to 35 minutes each) to administer all the tasks to the DS participants, depending on the participants' fatigue and motivation. Tasks were administered in a counterbalanced order and sessions took place over approximately one to two weeks. The research was approved by the Ethics Committee of the University of Geneva and authorizations from the institution, the legal guardians of the DS adults, and the school were obtained. Participants gave their oral consent to take part in the study, and were free to withdraw from the procedure at any time.

2.2.1 The Social Resolution Task (SRT)

The SRT (Barisnikov, Van der Linden, & Hippolyte, 2005) assesses the ability to judge the appropriateness of social behaviour based on knowledge of conventional and moral rules. It consists of 14 coloured drawings illustrating daily social situations. Five items depict an appropriate situation (e.g., helping an elderly lady to cross the street, cooperating in washing dishes) and nine items depict an inappropriate situation (e.g., failing to share cookies with a friend, destroying property). For each item, participants are asked by the experimenter whether the situation is appropriate or not. This first question assesses the ability to judge the situation from a general point of view. Then participants have to point to the element on which their judgement is based. This question considers the ability to identify the relevant constituent of the social situation. Finally, participants who answer that the situation is inappropriate (even if it is actually appropriate) are asked to explain why (question 3, understanding). This last question assesses the understanding of the situation in detail. A trial item depicting an appropriate situation is presented to ensure that participants understand the task.

A global SRT score (maximum = 105 points) and three subscores – one for each question asked by the experimenter – were calculated. In addition, separate scores could be calculated for the appropriate and inappropriate situations. For the first question, 2 points

were awarded if the answer was correct and 0 if it was wrong (judgement subscore; maximum= 28 points). For the second question, 1 point was awarded for a correct answer and 0 for a wrong one (identification subscore; maximum = 14 points). Finally, the last question was coded into four categories according to the participants' level of social understanding and cognitive reasoning. From 0 to 7 points were given for the explanation of each inappropriate situation (understanding subscore; maximum= 63 points); 0 points for an incorrect or inappropriate answer (level 0 response); 2 points for a description of the scene without social awareness (level 1 response); 5 points for an answer based on causality relations with social awareness (level 2 response); 7 points for an answer based on conceptual knowledge of conventional or moral rules (level 3 response).

3 Results

3.1 Comparison between groups on the SRT global score and subscores

The SRT data were investigated using four types of analysis: 1) a Student t-test analysis to compare the global SRT score between the groups, 2) non-parametric[39] analyses (Mann-Whitney *U* tests) to compare the subscores between the groups, 3) multilevel models (mixed effects models with crossed random effects) to control for the impact of the two SRT dimensions (conventional and moral), and 4) multiple regression analyses to investigate the impact of the different predictors on the SRT scores (for the inappropriate situations and for the global score) in interaction with the group variable and in the DS group alone.

The mean SRT global score (percentage) was 46.72 (*SD* = 15.46) for the DS group and 50.84 (*SD* = 10.63) for the control group. The Student t-test analysis showed that these two scores were not statistically different, $t(66) = -1.28$, $P = 0.21$. The two groups' mean SRT subscores related to the questions of judgement and identification (differentiating appropriate and inappropriate situations) are reported in Table 2 with their Mann-Whitney *U* values. For the appropriate situations, the two groups' performance did not differ. For the inappropriate situations, we observed that the DS group obtained significantly lower scores than the controls for both judgement ($P = 0.044$) and identification ($P = 0.018$) subscores. However, no differences were observed within groups between judgement and identification subscores according to the appropriateness of the situation.

[39] While the SRT global score was normally distributed, the distribution of the SRT subscores was continuous but asymmetric. Non-parametric analyses were therefore conducted on these subscores.

Table 2. Scores (percentage) of the DS and control groups for the judgement and identification questions of the SRT

	DS group	Control group	*Mann-Whitney U*
Judgement			
appropriate situation	84.1 (± 20.2)	89.7 (± 18.3)	485.5
inappropriate situation	77.5 (± 22.6)	87.9 (± 14.6)	419*
Identification			
appropriate situation	68.8 (± 30.4)	82.4 (± 22.9)	434
inappropriate situation	68.6 (± 26)	83 (± 18.4)	388*

* $P < 0.05$

We then analysed the SRT understanding subscore for the two groups (inappropriate situations only). No differences appeared between the DS group (mean percentage score = 27, *SD* =14.6) and the control group (mean percentage score = 27.1, *SD* =10.2) when we considered the global subscore, $U = 552$, $P = 0.75$. Finally, the levels of social understanding (number of items for each level) reached by the two groups were investigated (see Figure 1). As expected, the DS adults failed significantly more of these items than the controls ($U = 387.5$, $P = 0.017$). However, it was observed that, when they correctly judged and identified the situations, they gave fewer incorrect or inappropriate answers (level 0) than the control group ($U = 384$, $P = 0.015$). The two groups' subscores did not differ for the explanation of the situations at levels 1, 2 and 3.

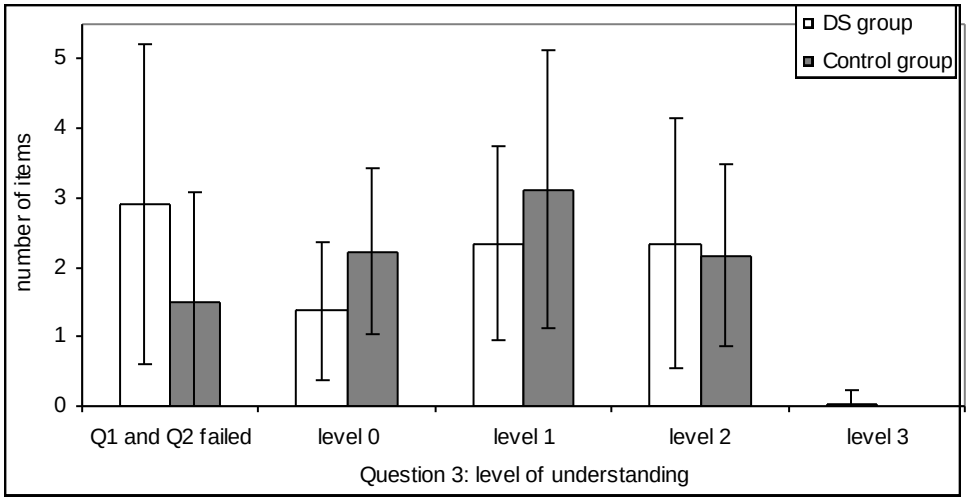

Figure 1. Number of items (inappropriate situations) obtained for each level of representation in the understanding subscore for both groups.

The SRT assesses the ability to judge the appropriateness of social behaviour based on knowledge of conventional (3 items) and moral rules (6 items). According to the developmental literature, differences have been found concerning these two kinds of items (Turiel, 1983) and we decided to test for a difference between these two dimensions on the SRT score. We ran a mixed effects model with subject and item as crossed random effects on the SRT and with the group and type of item as factors. No differences were found between the items testing moral versus conventional rules for the two groups.

Analyses of the SRT subscores revealed that the DS adults had more difficulties judging and identifying inappropriate social situations than the controls. In order to examine the potential variables that might explain this inter-group difference, we conducted a multiple regression analysis on a compound score related to the inappropriate situations[40] (judgement and identification subscores together). As predictors for this analysis, we used the cognitive scores on the Evip-R (receptive vocabulary task), Rabbits and Faces (selective attention subtests) and CA and the interaction of these variables with group. The best model found explained almost 40% of the variance in the dependent variable ($R^2 = 0.39$ and R^2 adjusted = 0.35). We observed a main negative effect of the Rabbits subtest (response time), ($\beta = –0.42$; $t(63) = –3.35$, $P = 0.001$) and a positive main effect of the Evip-R ($\beta = 0.25$; $t(63) = 2.35$; $P = 0.022$), while the main effect of group in the complete model was not significant ($P = 0.67$). There was a significant interaction between group and the Evip-R, ($\beta = 0.22$; $t(63) = 2.18$; $P = 0.033$). The analysis of the interaction revealed that the Evip-R had a greater impact on the DS group's score ($\beta = 0.45$), than on the control group's score ($\beta = 0.03$).

The same analysis was then done on the SRT global score. The best model explained nearly 45% of the SRT global score's variance ($R^2 = 0.49$ and R^2 adjusted = 0.45). There was a main negative effect of the Rabbits subtest (response time), ($\beta = –0.38$; t (60) = –3.09, $P = 0.003$), a marginal positive effect of the Evip-R ($\beta = 0.20$; $t(60) = 1.86$; $P = 0.068$), and a positive effect of the Faces subtest (precision score), ($\beta = 0.33$; $t(60) = 2.71$; $P = 0.009$). The main effect of group was not significant ($P = 0.154$). Finally, we found a significant interaction between group and the Evip-R, ($\beta = 0.30$; $t(60) = 2.98$; $P = 0.004$). The analysis of the interaction again showed a greater impact of the Evip-R variable on the DS group's score ($\beta = 0.50$) than for the control group's score ($\beta = –0.09$).

3.2 Analysis of the SRT global score for the DS group

[40] We did not conduct regression analyses on appropriate situations, as no differences were found across groups for those situations.

A multiple linear regression analysis was conducted on the DS group's SRT global score introducing whole cognitive variables (i.e., non-verbal reasoning, productive and receptive vocabulary, attention, inhibition), CA and the socio-emotional behaviour questionnaire. To explore the data, we first looked at the correlations between the SRT and the explanatory variables. As expected, significant relations were found with the Evip-R task (r = 0.058, P < 0.001), and the two selective attention subtests (Rabbits response time: r = –0.43, P = 0.012; Faces precision score: r = 0.41, P = 0.015). Positive relations were found with two additional cognitive measures: the Isadyle productive vocabulary task (r = 0.53, P = 0.001) and the tapping inhibition task (r = 0.35, P = 0.048). Finally, a negative relation appeared with subscale 5, 'social relating' from the DBC-A checklist (r = –0.42, P = 0.014).

The best regression model found explained over 50% of the variance in the SRT global score (R^2= 0.56 and R^2 adjusted = 0.51). It included three predictors: the Evip-R, (β = 0.52; t(30) = 4.23; P < 0.001), subscale 5, 'social relating' from the DBC-A (β = –0.35; t(30) = –2.84; P = 0.008), and the Faces precision score (β = 0.26; t(30) = 2.01; P = 0.049).

4 Discussion

The main objective of this study was to investigate social reasoning skills in adults with DS by using a new task specifically created for people with ID. Indeed, no previous studies had examined these competences in DS adults by means of an experimental design. The SRT assesses the judgement of appropriateness of social behaviour. We administered it to a group of 34 participants with DS whose results were compared to those of a control group matched on a receptive vocabulary task. We also wanted to examine the role that general cognitive abilities might play in success on this task. We focused particularly on factors that had already been identified as critical in studies reporting on socio-emotional skills such as language and executive functions. The potential differences which might appear between the two groups were explored using the cognitive measures available to all participants. In addition, we were interested in investigating the relations between social reasoning skills, as measured by the SRT experimental task, and a caregiver-rated measure of the DS adults' socio-emotional behaviour.

The DS participants' global SRT scores did not differ from those of the control group. However, analyses of the SRT subscores revealed differences between the two groups depending on the appropriateness of the situations. For the appropriate situations, the DS adults judged and identified the pertinent element of the items similarly to controls. On the

other hand, they obtained lower judgement and identification subscores for the inappropriate situations, showing that they found these situations more difficult to process than the controls. Interestingly, although the DS adults on the whole processed fewer inappropriate situations correctly than the control group, the two groups performed similarly for understanding. The analysis of the levels of social understanding achieved by the two groups explained this result. In fact, we noticed that the DS group gave fewer inappropriate answers (level 0 responses) to the social scenes than the controls did (e.g., when seeing a man destroying a street lamp with a baseball bat: 'this is wrong as he may hurt himself with the glass fragments'). Regarding the level 1 and 2 responses, it was found that both groups provided as many factual responses (e.g., 'it is bad to break the street lamp') as responses showing social awareness (e.g., 'then it is all dark in the street, and this is dangerous for the other people'). With the exception of one adult with DS, none of the participants made a response based on conceptual knowledge (level 3 responses). It should be noted that this level of response does not emerge before the age of 9 or 10 in TD children (Barisnikov, Hippolyte, Pizzo, & Urben, in preparation).

According to previous studies of socio-emotional competences in the DS population, we might have expected a poorer understanding of inappropriate situations than in the control group. Yet the DS adults' results could be related to their own life experience; they might be familiar with the social situations presented in the SRT and even be regularly confronted with some of them (e.g., queuing politely at the post office). In addition, these situations might be frequently discussed with caregivers and families (respecting other people's private life, being careful with other people's equipment). To test this assumption, it would be necessary to examine other adult populations with ID and see whether they perform similarly on the SRT. Moreover, people with DS are frequently reported to demonstrate empathy and care for others (S. Buckley, Bird, & Sacks, 2002; Kasari, Freeman, & Bass, 2003). This trait might have a positive impact on their understanding of social interactions. In order to investigate this issue, it would be interesting to compare their results to those of other populations showing a similar cognitive profile but a different character (e.g., people with autism and ID or fragile X).

In the present study, we were interested in investigating the relationships between general cognitive competences (receptive vocabulary and selective attention) and success on the SRT for all participants. For this purpose, multiple regression analyses were run on the SRT global score, as well as on the compound score including judgement and identification of the inappropriate situations, as the DS adults processed them worse than the controls. These two analyses gave similar results. The selective attention competences (Rabbits subtest response time and Faces subtest precision score) were significant predictors for all DS and

control participants. This relationship can be explained by the demands of the SRT, as participants have to focus their attention on the pertinent elements of the drawings linked to social interactions. The role of attentional skills had already been highlighted by the successful performance of socio-emotional and theory of mind related tasks by TD children and people with ID (Hughes, 1998; Thirion-Marissiaux & Nader-Grosbois, 2008b).

The influence of receptive vocabulary skills also stood out, but the interaction between group and the Evip-R revealed that the impact of this variable differed according to group; the Evip-R variable appeared to be a critical predictor for the DS group, while its influence was much weaker in the control group. In relation to the DS participants, these results were similar to previous findings reporting positive relations between receptive language and socio-emotional competences such as emotion processing (Hippolyte et al., 2008; Hippolyte, Barisnikov et al., 2009) and abilities related to theory of mind (Yirmiya et al., 1998). In relation to the control group, we might suggest that this language measure is less pertinent for TD children. Indeed, the developmental literature shows that receptive vocabulary has a weaker relationship than measures of general language with tasks related to theory of mind (Milligan et al., 2007), even when these tasks (e.g., false belief) are strongly related to receptive language. In addition, the SRT makes considerable demands on expressive language, which was not measured in this group. It is therefore possible that other language measures (e.g., narrative skills, syntax) would be related to SRT performance in TD children.

The focus of the present study was the DS population, and additional cognitive variables (non-verbal reasoning, productive vocabulary, inhibition of a predominant response) and a measure of socio-emotional behaviour (DBC-A checklist) were assessed, allowing for a more in-depth investigation of the competences potentially involved in the SRT success. The best regression model, which accounted for more than 50% of the variance in the SRT global score, included three predictors: the receptive vocabulary task Evip-R, the 'social relating' subscale of the DBC-A and the precision score of the Faces subtest. These results confirmed the impact of receptive language and selective attention on successful performance on the SRT.

With regard to receptive vocabulary, the analyses showed that this measure was more central than productive vocabulary (Isadyle) to success on the SRT. This result is important, as the SRT, which requires a verbal response, is strongly related to productive language. Moreover, people with DS present an asynchrony between receptive and expressive language, with the latter being weaker (Chapman & Hesketh, 2000). Considering these elements, a methodological artefact could have been inferred in the DS group if the Isadyle measure had

been more strongly related to the SRT than the Evip-R; in this case, the DS participants' performance might mainly depend on their linguistic impairments. Based on our results, we can consider that the conceptual representation of social objects is decisive in the DS adults' performance. Participants with a poorer receptive vocabulary level might have difficulties understanding these concepts, which are central to figuring out social situations.

Interestingly, a subscale of the DBC checklist proved to be significant in the model, showing an association between the caregiver-rated measure of social behaviour and social reasoning skills measured by an experimental task. The 'social relating' subscale mainly refers to social avoidance behaviour (remains aloof, prefers to do things on his/her own, resists being cuddled by close friends or family). The DS participants who were rated as more 'socially avoidant' by their referent caregivers performed poorly on the SRT. To our knowledge, such a relationship has never been pointed out in the literature looking into the links between social reasoning skills and behaviour in adults with ID or in TD children. Indeed, the factor that has always been found to be related to poor social reasoning skills is aggressiveness (Basquill et al., 2004; Crane-Ross, Tisak, & Tisak, 1998; Harvey et al., 2001; van Nieuwenhuijzen, Orobio de Castro, van Aken, & Matthys, 2009). Yet in our study no relations appeared with this factor, which can be referred to the DBC 'disruptive' subscale (describes abusive, provocative, or irritable behaviour). We might explain this absence of relationship by the fact that very few difficulties were reported on the 'disruptive' subscale; the aggressiveness factor therefore appeared to be of little relevance in our DS population. In addition, previous studies conducted on people with ID separated them into groups according to their aggressiveness level (not aggressive versus very aggressive). We suggest that studies including a more representative population could observe relations with other components of socio-emotional behaviour.

Regarding the results found in the DS group concerning the SRT's relation to the 'social relating' subscale, it can be hypothesized that the adults who understand social interactions poorly tend to stay in the background. They may prefer to avoid situations that they do not understand as these episodes could be stressful or unpleasant (e.g., sharing something reluctantly, having to be nice to people one dislikes). By implication, a vicious circle is created, as such people will miss out on opportunities to learn these skills because of their withdrawal. It is difficult to discern the main causes of a poorer understanding of social interactions, but personality factors could be an avenue worth exploring. For instance, we might hypothesize that DS participants with less empathetic sensitivity would be at a

disadvantage in understanding interactions. It would be interesting to clarify these issues in further studies.

To conclude, the SRT seems to have the correct sensitivity to assess people with mild and moderate ID and constitutes a promising tool for studying social reasoning skills in this population. Indeed, the SRT would also be useful for other clinical populations with a particular socio-emotional profile, such as Williams syndrome, fragile X, or autism and ID. The DS adults' ability to understand the appropriateness of others' social behaviour appears to be related to specific cognitive and socio-emotional skills, which opens up prospects for rehabilitation programmes. It would be important to work on selective attention and receptive language abilities, as they proved to be central to success on the SRT. Moreover, improving the social reasoning skills of socially withdrawn participants might have a positive impact on their integration.

As this is the first study reporting on social reasoning skills in DS adults, further studies are now required to see if the present findings can be confirmed. In addition, we need to conduct comparative studies assessing populations who present ID with another origin to find out whether the pattern found for our adult group is specific to DS or not. In relation to the measure of the DS adults' socio-emotional behaviour, the DBC-A was completed by the sheltered workshop referent who provided the profiles of our participants at their workplace. As adults may behave differently outside the work setting, it would be interesting to assess their profiles in their typical living environment and see if the 'social relating' subscale is still a significant predictor. Finally, it should be noted that the SRT assesses social reasoning skills through static stimuli. It would therefore be interesting to compare the SRT's results with those of a task that provides dynamic stimuli (e.g., staged social scenes presented on a video).

III. Discussion Générale

L'objectif de notre travail était d'explorer certaines compétences de traitement des informations émotionnelles et sociales chez les adultes avec SD, en nous intéressant également aux liens entre ces compétences socio-émotionnelles spécifiques, les capacités de raisonnement social et les capacités cognitives générales telles que le raisonnement non verbal, le langage, l'inhibition et l'attention. Nous nous proposons dans un premier temps de résumer les résultats que nous avons obtenus, puis de discuter leurs apports et leurs limites. Enfin, nous évoquerons les perspectives cliniques que ces recherches ouvrent.

1 Synthèse des résultats

Etude 1

Cette première étude avait pour but d'explorer les compétences de reconnaissance des expressions faciales chez les adultes avec SD. Trois tâches évaluant les expressions sous différentes modalités (identification, appariement et discrimination) ainsi qu'une tâche de contrôle pour le traitement des visages ont été administrées à 17 participants (8 hommes, 9 femmes) avec SD (âge moyen de 33.3 ans ± 10.5). Cinq expressions ont été évaluées (joie, colère, tristesse, surprise et neutre), de même que l'intensité (faible et forte) pour les émotions de joie et de tristesse dans la tâche de discrimination. Les résultats des adultes ont été comparés à ceux d'enfants au développement normal (âge moyen de 5.9 ans ± 0.7) appariés sur le genre et le niveau de vocabulaire réceptif (mesuré par l'Echelle de vocabulaire en images Peabody-révisée, EVIP-R; L. Dunn et al., 1993). Les adultes sélectionnés pour cette recherche[41] travaillaient dans des ateliers protégés, et ne présentaient pas de déficits sensoriels (audition, vision) ou moteurs importants, ni de symptômes cliniques de démence.

Les principaux résultats ont montré que les performances des adultes avec SD ne se distinguent pas de celles des enfants au développement normal dans la tâche de traitement des visages. Ils présentent par contre des déficits spécifiques dans la reconnaissance des expressions de surprise et des expressions neutres. En ce qui concerne les modalités d'évaluation des expressions, nous avons observé que les participants avec SD ont significativement plus de difficultés dans la condition d'appariement que dans les conditions

[41] Ces critères de sélection ont également été appliqués dans les études 2, 3 et 4.

d'identification et de discrimination. L'analyse du pattern de réponses de l'ensemble des participants indique un profil de réponses chez les adultes avec SD quelque peu différent de celui observé chez les enfants avec SD par Kasari et al. (2001) et Porter et al. (2007). On note en effet que les adultes confondent rarement les émotions de joie et de tristesse. Par contre, ils ont tendance à maximiser l'émotion de joie et minimiser l'émotion de tristesse, alors que les enfants de contrôle tendent à maximiser ces deux émotions. Par ailleurs, l'expression neutre, mal reconnue par les participants avec SD, a été plus fréquemment confondue avec la joie qu'avec la tristesse. A partir de ces résultats, nous avons fait l'hypothèse que les adultes avec SD présentent un biais de positivité dans leur jugement des expressions émotionnelles, ce qui rejoint les conclusions de Porter et al. (2007). Nous avons également observé une relation négative et significative entre ce score de biais émotionnel et une tâche d'inhibition verbale, suggérant que les adultes avec SD pourraient avoir des difficultés à inhiber cette réponse émotionnelle.

A l'instar des études menées chez les enfants avec SD, nous n'avons relevé aucune relation entre les performances dans les tâches de reconnaissance des émotions et les compétences de raisonnement non verbal chez les adultes (matrices en couleur de Raven) ou l'âge chronologique. Nous avons par contre observé des relations positives et significatives entre le niveau de vocabulaire réceptif et la reconnaissance de la surprise et de l'expression neutre. Ces résultats suggèrent que la représentation sémantique de ces deux expressions serait plus complexe pour les adultes avec SD en comparaison à celle des émotions de joie, colère ou tristesse.

Etude 2

L'étude 2 a porté sur une population de 24 adultes avec SD (17 hommes, 7 femmes) d'un âge moyen de 34.3 ans (± 7.1). Leurs résultats ont été comparés à ceux d'enfants au développement normal (âge moyen de 5.9 ans ± 1.6) appariés sur le genre et le niveau de vocabulaire réceptif (EVIP-R). Cette étude, présentée en deux parties, s'est intéressée à la reconnaissance des expressions faciales (partie 1) et à l'attribution d'une émotion en fonction d'un contexte (partie 2). La première partie a consisté en une réplication du protocole expérimental de l'étude 1, introduisant toutefois des modifications méthodologiques jugées pertinentes à la suite des premiers résultats obtenus. Le nombre d'items et de distracteurs a ainsi été augmenté dans les tâches d'identification et d'appariement des expressions, de même que de nouveaux items pour l'expression neutre ont été introduits dans ces deux épreuves.

Les résultats principaux de l'étude 1 sont globalement retrouvés. Ainsi, les performances des adultes avec SD ne se différencient pas de celles des enfants au développement normal dans la tâche de traitement des visages sans expression émotionnelle. Des difficultés importantes pour la reconnaissance de l'expression neutre sont à nouveau observées chez les adultes, et ce quelle que soit la modalité de la tâche. La tâche d'appariement des expressions apparaît également plus difficile pour les participants avec SD, en comparaison aux conditions d'identification ou de discrimination. Le biais de positivité dans le jugement des expressions faciales est retrouvé dans le groupe avec SD, qui évalue les expressions de façon plus positive que le groupe de contrôle. Toutefois, la tendance à minimiser l'intensité de l'émotion de tristesse n'est pas significative dans cette étude. Enfin, nous retrouvons les relations positives entre le niveau de vocabulaire réceptif et les scores de réussite pour certaines expressions, notamment l'expression neutre.

Dans la deuxième partie de l'étude 2, une tâche d'attribution des émotions en fonction d'un contexte (images présentant un personnage principal dans des situations suscitant les émotions de joie, tristesse, colère et peur) a été administrée aux mêmes participants. Les résultats montrent que le groupe des adultes avec SD ne se distingue significativement de leur groupe de contrôle que pour l'attribution des items suscitant la tristesse, pour lesquels ils obtiennent une performance beaucoup plus faible. L'analyse du pattern de réponses réalisée pour l'ensemble des participants indique que les adultes avec SD ont tendance à attribuer l'émotion de joie pour les items relatifs à la tristesse. Une partie de ces erreurs pourraient être expliquées par une observation notée au cours de la passation de la tâche. Il semble que plusieurs participants n'aient pas identifié l'élément pertinent suscitant la tristesse sur certaines images, attribuant alors à ces items l'émotion de joie. Cette hypothèse est soutenue par les corrélations significatives et positives observées dans les deux groupes entre le score de réussite pour l'émotion de tristesse et les mesures d'attention sélective.

Par ailleurs, l'analyse des réponses révèle que l'émotion de tristesse est très peu sélectionnée par le groupe avec SD tout au long de la passation, suggérant que les adultes avec SD évitent délibérément d'attribuer cette émotion. Il faut relever que cette tendance est spécifique à la tristesse, et ne s'applique pas aux deux autres émotions négatives de peur et de colère. Enfin, les analyses corrélationnelles montrent que les compétences d'attribution des émotions ne sont liées ni avec les mesures de raisonnement non verbal ni avec le vocabulaire réceptif chez les adultes avec SD. En outre, peu de relations apparaissent entre la tâche d'attribution et celles de reconnaissance des expressions faciales (partie 1) ; seul le score

d'attribution pour la tristesse est positivement corrélé aux scores globaux des tâches d'identification et d'appariement des expressions faciales.

Etude 3

L'objectif de cette étude était d'explorer les relations entre le biais émotionnel relevé dans le jugement des expressions faciales chez les adultes avec SD (études 1 et 2) et l'inhibition. Dans l'étude 1, nous avons en effet noté que ce biais était plus important chez les participants ayant de moins bonnes compétences dans une tâche d'inhibition de réponse verbale dominante. A partir de ces résultats, nous avons suggéré que les adultes avec SD pourraient avoir des difficultés à inhiber leur tendance à répondre sur un mode émotionnel positif face à certains stimuli émotionnels. Afin d'investiguer cette hypothèse, nous avons élaboré un paradigme comparant les capacités d'inhibition d'une réponse dominante sur un matériel émotionnel (visage d'un enfant présentant une expression de tristesse ou de joie) aux capacités d'inhibition d'une réponse dominante sur un matériel neutre (image d'une lune ou d'un soleil, procédure adaptée de Gerstadt et al., 1994). Deux tâches ont ainsi été élaborées, chacune étant constituée de deux parties. Dans la première partie de la tâche émotionnelle (partie 1 : contrôle), nous avons demandé au participant de dire « triste » lorsqu'il voyait l'image de l'enfant avec l'expression de tristesse et « content » lorsqu'il voyait l'image de l'enfant avec l'expression de joie. La deuxième partie (partie 2 : inhibition) a été administrée directement à la suite de la première. Cette fois, la consigne inverse a été donnée au participant qui devait répondre « content » pour le visage avec l'expression de tristesse, et « triste » pour le visage avec l'expression de joie. La tâche d'inhibition avec le matériel au contenu neutre a été construite sur le même modèle. L'ordre de présentation de ces deux tâches a été contrebalancé entre les participants et elles ont été administrées sur deux sessions (avec une à deux semaines d'écart entre les sessions).

Les résultats de 49 participants avec SD (31 hommes, 18 femmes ; âge moyen de 33.7 ans ± 9) ont été comparés à ceux d'enfants au développement normal appariés individuellement sur le genre et le niveau de vocabulaire réceptif (EVIP-R) (âge moyen de 5.9 ans ± 1.1). Les résultats révèlent que les performances des deux groupes sont proches de 100% dans la partie 1, quel que soit le matériel présenté. Dans la partie 2, les groupes présentent des patterns de performance distincts. Les enfants de contrôle réussissent avec facilité les deux tâches, alors que les adultes avec SD commettent plus d'erreurs dans la tâche au contenu émotionnel (différence significative avec le groupe de contrôle). Ces résultats

confirment l'hypothèse que les adultes avec SD ont des difficultés spécifiques pour inhiber une réponse émotionnelle dominante. Au niveau des temps de réponse, les deux groupes présentent un pattern similaire, les items au contenu neutre étant traités plus rapidement que les items au contenu émotionnel. Ces résultats concordent avec les données de la littérature, qui relèvent que dans ce type de paradigme, les temps de réponse pour les stimuli émotionnels sont plus longs que ceux pour les stimuli non-émotionnels. Enfin, et contrairement à notre hypothèse de départ, la valence émotionnelle du visage n'a pas d'influence sur les performances des adultes avec SD. Aucune différence n'apparaît entre le niveau de réussite et les temps de réponses pour les visages joyeux et tristes pour l'ensemble des participants.

Etude 4

La dernière étude de ce travail a été consacrée à l'exploration des compétences de raisonnement social chez les adultes avec SD. Les liens entre ces compétences socio-cognitives spécifiques, les capacités cognitives générales (vocabulaire réceptif et productif, raisonnement non verbal, inhibition verbale et motrice, attention sélective) et le profil socio-émotionnel ont également été investigués. Dans cette perspective, nous avons proposé à 34 adultes avec SD (22 hommes, 12 femmes; âge moyen de 32.2 ans ± 9.6) et 34 participants de contrôle (enfants au développement normal appariés sur le genre et le niveau de vocabulaire réceptif à l'EVIP-R, âge moyen = 5.7 ans ± 1.6) une tâche évaluant la compréhension du comportement social. Cette tâche présentait des dessins, illustrant des situations sociales pouvant être appropriées ou non sur la base de règles conventionnelles ou morales. Les participants devaient tout d'abord juger si la situation leur paraissait correcte ou non, puis identifier dans un deuxième temps l'élément du dessin ayant motivé leur choix. Enfin, si la situation était jugée incorrecte, on leur demandait d'en donner les raisons.

Les résultats montrent que si les adultes avec SD ne se différencient pas de leur groupe de contrôle quand ils traitent les situations sociales appropriées, ils obtiennent des performances plus faibles dans le jugement et l'identification des situations inappropriées. On constate cependant que lorsque les adultes ont été capables de reconnaître le comportement inapproprié, ils peuvent expliquer sur quoi leur raisonnement repose aussi bien que les enfants de contrôle. Deux compétences cognitives générales, la compréhension langagière et l'attention sélective, apparaissent plus spécifiquement liées à la réussite de cette épreuve chez les adultes avec SD. Par ailleurs, on observe également une relation significative avec le profil socio-émotionnel ; les personnes évaluées par leur éducateur comme ayant plus de difficultés

dans la sous-échelle « interaction sociale » de l'échelle de comportement *Developmental Behaviour Checklist* (Einfeld & Tonge, 2002) obtiennent de moins bonnes performances dans la tâche de raisonnement social. Cette sous-échelle se réfère principalement à des comportements d'évitement social (« *n'aime pas qu'on soit proche de lui* », « *préfère être seul* », « *distant* »), ce qui suggère que les participants avec SD qui se montrent plus en retrait ont une moins bonne connaissance des règles sociales. Les résultats de cette étude révèlent ainsi l'implication conjointe de compétences cognitives générales et de compétences relationnelles dans la compréhension du comportement social d'autrui chez les adultes avec SD.

2 Discussion des résultats

Nous nous proposons de discuter les résultats de nos différentes études en faisant référence aux travaux portant sur les enfants avec SD et aux données issues de la littérature développementale. Nous tenterons également d'intégrer les résultats des études 1, 2 et 3 sur le traitement des émotions au sein d'un modèle synthétique visant à mieux comprendre les processus liés au traitement des expressions faciales chez les adultes avec SD. Enfin, nous aborderons les perspectives cliniques de ce travail.

2.1 Spécificités dans la reconnaissance des expressions faciales

Un des objectifs majeurs de ce travail était d'explorer les compétences de reconnaissance des expressions faciales chez les adultes avec SD. Si quelques études se sont penchées sur ces compétences dans des populations d'enfants avec SD (Kasari et al., 2001; Porter et al., 2007; K. Williams et al., 2005; Wishart & Pitcairn, 2000), il n'existe pas, à notre connaissance, de travaux comparables menés chez les adultes. Nous avons consacré deux études (études 1 et 2) à l'examen de cette question.

De manière générale, nos résultats ont mis en évidence des spécificités dans la reconnaissance des expressions faciales chez les adultes avec SD. La reconnaissance de certaines expressions semble être particulièrement compromise, telle que la reconnaissance de l'expression neutre ou encore de la surprise. Les performances des adultes avec SD, comparées à celles d'enfants au développement normal appariés sur le niveau de compréhension verbale, suggèrent que ces personnes ne présentent pas un retard simple par rapport à une trajectoire développementale attendue. On note plutôt un pattern de réponses qui leur est spécifique, avec des forces et des faiblesses en fonction des expressions à traiter. Par

ailleurs, les adultes avec SD obtiennent des performances similaires à celles des enfants de contrôle dans les tâches évaluant les processus plus généraux de traitement des visages (études 1 et 2), corroborant les résultats retrouvés dans les études portant sur les enfants avec SD (Celani et al., 1999; K. Williams et al., 2005; Wishart et al., 2007; Wishart & Pitcairn, 2000). En effet, dans une tâche d'appariement des visages selon leur identité, le taux de réussite des participants avec SD est proche de 100% lorsque les visages sont présentés dans leur intégralité. On note par ailleurs que ces bonnes performances sont confirmées dans l'étude 2, où le nombre de distracteurs passe de 1 à 2. Ces résultats soutiennent l'hypothèse que les difficultés des adultes avec SD sont spécifiques au traitement des expressions faciales, et ne découlent pas de difficultés plus fondamentales liées au traitement des visages.

2.1.1 Impact de la modalité d'évaluation

Comme nous l'avons vu dans la partie de l'introduction théorique portant sur la reconnaissance des expressions faciales, les études issues de la littérature développementale relèvent d'importantes variations dans les performances des participants en fonction de la modalité d'évaluation des émotions (Vicari, Reilly et al., 2000; Widen & Russell, 2003). Chez les enfants au développement normal, les épreuves d'appariement des émotions faisant uniquement appel aux aspects visuo-perceptifs sont généralement moins bien réussies que celles introduisant une composante sémantique émotionnelle, comme les tâches d'identification ou de dénomination. Dans la synthèse de la littérature sur le SD, nous avons également souligné que les enfants avec SD semblent avoir plus de difficultés dans les tâches d'appariement des émotions que dans les tâches d'identification, même si l'émotion des visages à apparier est donnée oralement par l'expérimentateur (K. Williams et al., 2005; Wishart et al., 2007; Wishart & Pitcairn, 2000). En outre, les performances des enfants avec SD dans les tâches de dénomination des émotions sont également plus faibles que celles des enfants de contrôle (Kasari et al., 2001 ; Porter et al., 2007).

Dans les études 1 et 2 du présent travail, nous avons relevé que les résultats des adultes avec SD varient fortement en fonction de la modalité dans laquelle les expressions faciales doivent être reconnues. L'appariement des visages selon l'émotion (ici l'émotion n'est pas donnée oralement) apparaît ainsi moins bien réussi que l'identification ou la discrimination des expressions faciales. Pour exemple, les performances pour l'expression de joie (expression qui est généralement très bien traitée par les participants dans les deux études) sont déficitaires dans la modalité d'appariement (étude 2). Ces résultats démontrent l'influence déterminante de la modalité d'évaluation des expressions émotionnelles sur la

réussite des personnes avec SD. Les difficultés massives observées dans nos deux études pour la tâche d'appariement (faibles performances dans toutes les expressions) pourraient être liées à des exigences plus importantes au niveau des capacités à se représenter les émotions en comparaison aux deux autres épreuves proposées. En effet, pour réussir cette épreuve il faut tout d'abord reconnaître l'expression que présente le visage cible afin de pouvoir, dans un deuxième temps, l'identifier sur un autre visage. Le participant doit donc être capable de reconnaître cette émotion quelque soit son support (généralisation de l'expression à différents visages). Ces processus nous paraissent ainsi plus complexes que ceux impliqués dans les tâches d'identification ou de discrimination des expressions, où le participant ne doit traiter l'émotion que sur un seul visage à la fois. Soutenant cette hypothèse, on note que l'âge chronologique est positivement lié à la réussite de cette épreuve d'appariement dans le groupe des enfants de contrôle (étude 2). Par ailleurs, les données issues de la littérature développementale concordent avec cette interprétation, les tâches d'identification ou de dénomination (choix forcé) des émotions étant réussies plus tôt dans le développement que celles d'appariement (Bruce et al., 2000; Russell & Widen, 2002).

Nous pourrions toutefois émettre l'hypothèse que cette épreuve peut être réussie sans tenir compte de la composante émotionnelle, en réalisant un appariement basé uniquement sur les traits perceptifs des visages. Dans ce cas, le participant repérerait les traits faciaux présentant des similarités (par exemple l'ouverture de la bouche, la forme des sourcils) afin de réaliser l'appariement. Ce mode de traitement s'appuie plus spécifiquement sur les processus de traitement des visages, et on pourrait dès lors s'attendre à ce que les participants ayant de meilleures performances dans ces épreuves aient également plus de facilité dans la modalité d'appariement des expressions faciales. Ces relations ne sont cependant pas retrouvées dans les études 1 et 2, indiquant que cette stratégie ne serait pas utilisée par les adultes avec SD, ou alors utilisée mais sans succès. Comme nous l'avons vu dans l'introduction théorique, les expressions faciales partagent des traits en commun (ouverture de la bouche dans l'émotion de joie et de surprise par exemple), ces similarités visuelles pouvant créer des confusions entre certaines émotions (Gosselin, 2005). En outre, ce type de confusions est également observé dans les populations d'adultes sans troubles du développement, ce qui suggère qu'une technique d'appariement des émotions trait par trait possède un niveau de difficulté relativement élevé.

Les relations observées entre la tâche d'appariement des expressions faciales et les compétences cognitives générales révèlent par contre que la mesure du vocabulaire réceptif est positivement liée à l'épreuve d'appariement (score global pour l'étude 1 ; scores pour les

expressions de tristesse, surprise et neutre pour l'étude 2). La réussite de cette épreuve pourrait ainsi reposer sur une meilleure représentation conceptuelle des expressions émotionnelles. Toutefois, ces relations restent relativement modestes et il demeure difficile de comprendre la nature exacte de ces liens. Quoi qu'il en soit, les résultats obtenus dans nos deux études suggèrent que cette tâche d'appariement est peu adaptée pour évaluer les participants avec SD. La majorité d'entre eux se trouvent en échec devant cette épreuve, et il serait dès lors plus pertinent d'en proposer une version facilitée. Une possibilité intéressante serait de reprendre la procédure utilisée dans les études chez les enfants et adolescents avec SD (K. Williams et al., 2005; Wishart et al., 2007; Wishart & Pitcairn, 2000), en donnant oralement l'expression du visage cible au participant. En introduisant cette procédure dans le protocole d'évaluation, nous pourrions aussi examiner si l'appariement des émotions faciales pose spécifiquement un problème à la population avec SD, ou si une amélioration au niveau de ces compétences s'observe après l'adolescence.

2.1.2 Performances en fonction des expressions faciales à reconnaître

Comme nous l'avons vu dans le chapitre 3 de l'introduction théorique consacré à l'acquisition des concepts émotionnels, un certain ordre est observé dans l'apparition des émotions dites « de base » chez les enfants au développement normal. La majorité des études rapportent que l'émotion de joie est la première reconnue vers l'âge de 3 ans, suivie rapidement par la tristesse et la colère vers l'âge de 4 ans. La surprise, la peur et le dégoût viennent ensuite vers 5-6 ans. Dans les études 1 et 2 ayant évalué la reconnaissance des émotions de joie, tristesse, colère et surprise, nous notons que les performances des adultes avec SD suivent globalement cette hiérarchie. Toutefois, certaines spécificités peuvent être relevées.

En ce qui concerne la reconnaissance de la joie, les résultats retrouvés chez les adultes avec SD confirment les bonnes performances déjà observées dans la littérature chez l'enfant avec SD. A l'exception de la tâche d'appariement, les taux de réussite pour les items de joie dans les modalités d'identification et de discrimination avoisinent en moyenne les 90%. Cependant, certains éléments suggèrent que les performances obtenues dans la tâche de discrimination pourraient en partie découler d'un biais en faveur de la joie, augmentant les scores pour cette émotion. Dans l'étude 1, nous avons observé une relation négative entre le niveau de vocabulaire réceptif et le taux de réussite pour la joie, indiquant que les participants qui obtiennent les meilleures performances dans ces items ont paradoxalement une moins bonne compréhension langagière. Ces résultats peuvent être mis en parallèle avec ceux

obtenus dans l'étude de Porter et al. (2007), où une relation négative a été trouvée dans le groupe des participants avec SD entre le traitement de la joie et une mesure générale de l'âge mental (à l'échelle de Woodscock-Johnson). Suite à ces observations, nous pouvons émettre l'hypothèse que la performance maximale obtenue par les adultes avec SD pour la reconnaissance de l'émotion de joie serait liée au nombre accru de réponses *joie* données tout au long de l'évaluation. Cette hypothèse est en outre appuyée par l'analyse du pattern de réponses des participants avec SD où l'on relève que la réponse *joie* est plus souvent proposée que les réponses *triste* ou *neutre* (études 1 et 2). Toutefois, le pattern de réponses observé chez les participants avec SD dans les études 1 et 2 suggère que le biais pour le traitement des expressions faciales est plus complexe, et ne repose pas uniquement sur une augmentation systématique des réponses *joie* dans la tâche de discrimination. La découverte de ce pattern de traitement particulier constitue un aspect important de notre travail, sur lequel nous reviendrons dans le point suivant.

En ce qui concerne les expressions de tristesse et de colère, les résultats obtenus dans les études 1 et 2 indiquent que les adultes avec SD possèdent une bonne reconnaissance de ces deux expressions. Ces résultats ne sont pas spécifiquement remarquables si nous considérons les données de la littérature développementale, montrant que la reconnaissance de ces émotions apparaît chez les enfants juste après la joie, vers l'âge de 4 ans. Toutefois, nous relevons que les performances obtenues par les adultes avec SD dans nos études contrastent avec les travaux menés chez les enfants et adolescents avec SD, où des difficultés significatives sont rapportées dans le traitement de ces expressions (Kasari et al., 2001; Porter et al., 2007; K. Williams et al., 2005). Ces données ont une importance particulière puisqu'elles suggérent un développement de la reconnaissance de ces émotions après l'adolescence chez les personnes avec SD. Comme nous l'avons vu auparavant, les études menées auprès de populations d'enfants et d'adolescents avec SD n'ont relevé aucune relation entre les performances dans les tâches émotionnelles et l'âge chronologique. Elles concluent, de ce fait, que les enfants avec SD ne montreraient rapidement plus de progrès dans leurs compétences émotionnelles.

Une première hypothèse permettant d'expliquer ces progrès à l'âge adulte pourrait reposer sur l'évolution de l'environnement social des personnes avec SD au cours du développement. Nous avons vu dans notre introduction théorique que les enfants avec SD sont souvent considérés comme étant chaleureux et agréables dans leurs interactions sociales, et possédant un tempérament facile et complaisant (Gibbs & Thorpe, 1983 ; Rodgers, 1987 ; Wishart & Johnston, 1990). Au vu de ces différentes observations, Kasari et al. (2001) ont

suggéré que les personnes dans l'entourage de ces enfants (parents, proches, enseignants) seraient moins enclines à faire usage de termes émotionnels négatifs, avec pour conséquences une moins bonne compréhension de ces émotions par les enfants avec SD. A l'adolescence et au début de l'âge adulte, des changements s'opèrent dans la qualité des relations sociales entretenues par les personnes avec SD. Les études montrent en effet que vers la fin de l'adolescence, les personnes avec SD recherchent moins le contact et ont tendance à se renfermer sur elles-mêmes (Dykens, 2007 ; Dykens et al., 2002 ; Nicham et al., 2003). Nous avons notamment suggéré que ces comportements de retrait pourraient en partie découler de difficultés d'adaptation aux exigences de la vie professionnelle. Des interactions plus tendues et conflictuelles pourraient ainsi se mettre en place dans ce nouvel environnement, où l'expression d'émotions et de sentiments négatifs serait alors plus fréquente. En outre, nous avons également émis l'hypothèse que certaines caractéristiques physiques souvent observées dans le SD (surcharge pondérale, hypotonie, protrusion de la langue) entraîneraient une mise à l'écart de ces personnes à l'approche de l'adolescence, provoquant ainsi chez eux des sentiments de rejet. Dans ces conditions, ces nouvelles expériences personnelles amèneraient les adultes à développer leur compréhension d'émotions négatives, telles que la tristesse ou la colère. Il demeure toutefois très difficile d'examiner l'influence exacte de l'environnement social sur la compréhension des émotions chez ces personnes. En effet, l'environnement social est une construction extrêmement complexe, faisant intervenir de multiples facteurs (environnementaux, familiaux, cognitifs, etc.). En outre, l'hypothèse de Kasari et al. (2001) suggérant que les enfants avec SD évoluent dans un environnement où les émotions négatives sont peu présentes, nous paraît très discutable. Elle repose sur une vision idéaliste des enfants avec SD (enfants faciles, chaleureux, agréables), contrastant avec plusieurs études qui rapportent différents problèmes de comportement socio-émotionnel chez ces enfants (par exemple conduites d'opposition, attitudes butées, comportement intrusif) (Coe et al., 1999 ; Pueschel et al., 1991).

Si l'on s'intéresse maintenant aux relations entre les compétences cognitives générales et les scores de réussite pour les émotions de tristesse et de colère, on observe que l'expression de tristesse (tâche d'identification et de discrimination) n'apparaît significativement corrélée à aucune de ces mesures, alors que celle de colère (tâche d'identification) montre un lien avec la tâche de vocabulaire réceptif (résultats retrouvés dans les études 1 et 2). Lors des passations, nous avons remarqué que les deux expressions étaient généralement bien reconnues par l'ensemble des participants. Toutefois, certains adultes avaient des difficultés à faire la distinction entre la colère et la tristesse lorsque ces deux

émotions étaient présentées conjointement[42]. Dans ce cas de figure, ils avaient plus précisément tendance à sélectionner le visage triste à la place du visage en colère alors que l'erreur inverse n'était pas observée. Nous pouvons relever que ce type d'erreurs va dans le sens du modèle développemental de Russell (1980), où les confusions entre les concepts sont interprétées comme un manque de différentiation entre les catégories sémantiques des émotions. Ainsi, certains participants avec SD auraient de la peine à distinguer ces deux concepts à valence négative. Il est important de souligner que ces observations demandent à être confirmées puisque la tâche d'identification présentée dans les études 1 et 2 ne permet pas de réaliser une analyse du pattern de réponses des participants. Les différences retrouvées dans la nature des relations entre ces émotions et le niveau de vocabulaire réceptif suggèrent cependant que le concept de colère serait, pour les adultes avec SD, effectivement plus complexe à comprendre que celui de tristesse.

En ce qui concerne la reconnaissance de l'émotion de surprise, nous avons constaté dans les études 1 et 2 que les adultes avec SD ont des performances significativement inférieures à celles de leur groupe de contrôle (identification et appariement). Ces résultats rejoignent l'étude de Wishart et Pitcairn (2000) ayant rapporté un déficit pour cette expression (tâche d'appariement, émotion donnée oralement par l'expérimentateur) dans leur population d'enfants avec SD (âgés entre 8 et 14 ans). Il semblerait donc que les difficultés observées durant l'enfance pour reconnaître l'expression de surprise persistent à l'âge adulte. Dans les deux études, nous avons noté des liens positifs entre la mesure de vocabulaire réceptif et l'identification des visages surpris chez les adultes avec SD, suggérant que des difficultés au niveau de la représentation conceptuelle de cette expression pourraient entraver son identification. Les données de la littérature développementale montrent par ailleurs que les enfants reconnaissent plus tardivement l'émotion de surprise par rapport aux émotions de joie, tristesse et colère. Ces résultats suggèrent que ce concept émotionnel serait également plus difficile à appréhender pour les enfants au développement normal.

Notre compréhension des difficultés liées à la reconnaissance de la surprise chez les adultes avec SD reste très limitée ; nous pourrions toutefois formuler une hypothèse en prenant en compte une caractéristique particulière de cet état émotionnel de surprise, et qui est

[42] Pour rappel, le participant doit dans la tâche d'identification sélectionner parmi 3 visages celui qui présente l'expression émotionnelle donnée oralement par l'expérimentateur. Quatre items sont présentés pour chacune des 5 expressions (joie, colère, tristesse, surprise et neutre), et les expressions distractrices sont réparties équitablement entre les items (représentées 2 fois pour chaque expression).

celle de pouvoir être rattaché à des événements de valence émotionnelle variable[43]. Cette ambiguïté pourrait ainsi créer une confusion chez les personnes avec SD et interférer avec sa reconnaissance. Afin de mieux saisir le sens que les personnes attribuent à un visage surpris, il serait intéressant de proposer une tâche d'identification permettant d'analyser le pattern de réponses des participants (en augmentant par exemple le nombre d'items de 4 à 8), afin de voir si certains types de confusion sont plus fréquents.

En ce qui concerne finalement la reconnaissance de l'expression neutre, nous avons observé dans les études 1 et 2 que les performances des adultes avec SD sont très déficitaires pour cette expression, et ce dans toutes les modalités d'évaluation (identification, discrimination, appariement). Ce déficit est par ailleurs spécifique aux adultes avec SD, les enfants de contrôle obtenant des taux de réussite élevés pour la reconnaissance des visages neutres. Dans notre introduction théorique, nous avons vu que la reconnaissance de l'expression neutre a été extrêmement peu étudiée dans les populations sans troubles du développement[44]. Nous avons toutefois relevé deux études ayant proposé à des enfants au développement normal une tâche d'appariement (Herba et al. 2006) et une tâche d'attribution en fonction d'un contexte (Pons et al., 2004) utilisant cette expression. Ces dernières rapportent des taux de réussite relativement élevés pour ces items neutres, et ce dès l'âge de 5-6 ans. A notre connaissance, aucune étude n'a par contre évalué la reconnaissance du neutre auprès de personnes avec SD.

On peut cependant se référer à l'étude de Smith et Dodson (1996) qui a proposé à un groupe d'adultes avec SD une tâche d'attribution d'émotions en fonction d'un contexte, et dans laquelle figurait la condition neutre (vignettes vidéos suscitant les émotions de joie, de tristesse ou aucune émotion en particulier). Bien que cette tâche soit très éloignée des épreuves de reconnaissance des expressions proposées dans les études 1 et 2 (support vidéo, complexité élevée des stimuli, stimuli n'impliquant pas forcément des visages), il est intéressant de relever que les adultes avec SD sélectionnent peu la réponse neutre dans cette

[43] Plusieurs auteurs considèrent la surprise comme étant dépendante des attentes d'une personne, l'intensité de cette émotion étant d'autant plus grande lorsque la divergence par rapport aux attentes est importante (Scherer, 1984; Schützwohl, 1998). D'une durée très brève, l'émotion de surprise va céder la place à une émotion subséquente, et qui va donner la valence à cette expérience émotionnelle en fonction de son caractère plaisant ou déplaisant (Scherer, 1984). Pour Ekman et Friesen (1975), la personne va rattacher cette émotion à celle de surprise, la valence de l'émotion de surprise étant à la base neutre.

[44] Comme nous l'avons mentionné dans le chapitre 3 de notre introduction théorique, les études menées auprès des enfants au développement normal examinent essentiellement la reconnaissance des émotions dites « de base ». Le neutre, qu'on peut placer sur le modèle de Russell au croisement des axes plaisir-déplaisir et éveil-somnolence (Kaiser et al., 2009), reste un état laissé pour compte dans la littérature portant sur les populations non cliniques (enfants ou adultes). Si elle est utilisée dans plusieurs études en tant qu'expression distractrice (par exemple Batty & Taylor, 2006; Bimler & Paramei, 2006), la reconnaissance du neutre n'a pas été étudiée en tant que telle à notre connaissance.

étude. Selon Smith et Dodson, les difficultés observées dans le groupe avec SD pour la condition neutre seraient à mettre en lien avec leur niveau de fonctionnement cognitif, ne leur permettant pas d'attribuer une signification à ce concept. Toutefois, cette hypothèse n'a pas pu être vérifiée, puisqu'aucune mesure cognitive n'a été administrée dans leur travail.

Dans nos études 1 et 2, l'exploration des capacités de raisonnement non verbal, mesurées par les matrices progressives en couleur de Raven, n'a pas montré de relations significatives avec la reconnaissance des visages neutres chez les participants avec SD. Par contre, nous avons observé des liens positifs et relativement forts avec le niveau de vocabulaire réceptif, notamment dans la tâche de discrimination des expressions faciales. Ces relations suggèrent que les déficits des participants avec SD pour traiter l'expression neutre pourraient en partie reposer sur des difficultés à comprendre la signification de cette expression. Nous pourrions également émettre l'hypothèse que certaines personnes ne comprendraient pas la demande de la tâche pour ces items neutres, et seraient dès lors dans l'incapacité de la réaliser. Toutefois, les consignes données pour la condition neutre ont été présentées en des termes simples[45], qui semblent avoir été compris par l'ensemble des participants. Dans ces conditions, il est plus probable que les adultes avec SD n'aient délibérément pas sélectionné la réponse neutre (notamment pour la tâche de discrimination où l'émotion de joie a plus souvent été proposée à la place du neutre). Il serait important d'explorer plus en détail le sens que les personnes avec SD attribuent à cette expression, ainsi que d'examiner si leur tendance à ne pas choisir cette réponse « neutre » s'observe dans d'autres tâches n'impliquant pas les visages (par exemple attribution d'une expression en fonction d'un contexte).

Soulignons enfin que ce déficit pour la reconnaissance des visages neutres pourrait avoir une influence sur le comportement socio-émotionnel des adultes avec SD. Confrontés à des personnes présentant cette expression, certains adultes avec SD se trouveraient en difficulté, ne sachant pas comment y réagir ou l'interpréter. Au vu de la tendance des adultes avec SD à évaluer l'expression neutre comme de la joie, il serait possible qu'ils montrent des comportements inadaptés, telle qu'une attitude de rapprochement excessive par exemple. Ces difficultés avec le neutre pourraient ainsi leur porter préjudice pour développer et entretenir des relations sociales satisfaisantes. Il serait intéressant de regarder dans de futurs travaux si

[45] Voici pour exemple les consignes mentionnant la condition neutre dans les tâches d'identification et de discrimination des expressions : tâche d'identification *« montre-moi la personne qui se ressent rien de particulier, comme si rien de spécial ne s'était passé »* ; tâche de discrimination *« est-ce que cette personne se sent heureuse, triste ou ni heureuse ni triste ? ».*

des relations peuvent effectivement être mises à jour entre les capacités de reconnaissance des visages neutres et le profil socio-relationnel des personnes avec SD.

2.1.3 Mise en évidence d'un biais dans la reconnaissance des expressions faciales

Dans la tâche de discrimination des expressions faciales utilisée dans les études 1 et 2, les expressions de joie, de tristesse et neutres ont été évaluées, ainsi que l'intensité pour la joie et la tristesse (faible ou forte). A partir des données obtenues, nous avons pu calculer un score de biais de réponse[46] nous permettant d'explorer de façon plus précise la reconnaissance de ces expressions chez les adultes avec SD. Les résultats ont montré que les adultes avec SD ont une propension à juger les visages neutres, heureux et tristes de façon plus positive que les enfants de contrôle (score de biais significativement plus élevé dans l'étude 2, tendance significative dans l'étude 1). Ainsi, ils ont souvent attribué l'intensité forte pour les visages avec l'expression de joie, l'intensité faible pour les visages avec l'expression de tristesse, alors que les visages neutres ont plus souvent été jugés heureux que tristes. Il s'en suit que les erreurs de valences émotionnelles opposées semblent rares chez les adultes avec SD.

Les résultats obtenus chez les adultes avec SD concernant l'intensité des émotions de joie et de tristesse révèlent un pattern différent de celui observé chez les enfants au développement normal. Dans nos deux études, nous avons en effet observé que les enfants de contrôle ont obtenu des performances très élevées pour la reconnaissance des émotions de forte intensité, alors que les émotions de faible intensité ont été significativement moins bien reconnues. Ces résultats corroborent les données de la littérature développementale, montrant que les émotions de faible intensité sont traitées avec plus de difficulté par les populations d'enfants mais également d'adultes (Herba et al., 2006 ; Montirosso et al., sous presse). Dans le groupe des participants avec SD, un pattern semblable a été relevé pour l'émotion de joie. Toutefois, aucune différence n'est apparue entre les taux de réussite pour la reconnaissance des items tristes de forte ou de faible intensité. Il semblerait ainsi que les émotions d'intensité forte ne soient pas systématiquement mieux reconnues par les adultes avec SD comme c'est le cas dans la population sans troubles du développement. Un pattern de réponses relativement similaire a par ailleurs été observé par Smith et Dodson (1996) dans leur paradigme évaluant l'attribution des expressions de joie, tristesse et neutres auprès d'adultes avec SD. Ici les participants avec SD avaient tendance à évaluer les items joyeux comme plus joyeux, et les

[46] Pour rappel, le score de biais s'obtient en attribuant des points (positifs ou négatifs) pour chaque réponse erronée selon un barème donné (attribution d'un point par degré pour une expression jugée comme plus positive, et substitution d'un point par degré pour une expression jugée comme plus négative). Pour exemple, deux points sont attribués pour une réponse où le participant a jugé un visage neutre comme étant très heureux.

items tristes comme moins tristes en comparaison aux adultes de contrôle. Il serait très intéressant de poursuivre ces investigations, en évaluant la reconnaissance des intensités faibles et fortes d'autres expressions émotionnelles que la tristesse.

Si on se penche sur le pattern d'erreurs plus général retrouvé chez les adultes avec SD dans les études 1 et 2, on remarque qu'il se distingue des résultats rapportés auprès des participants avec SD par Kasari et al. (2001) et Porter et al. (2007), où l'émotion de joie est souvent proposée à la place d'émotions négatives telles que la tristesse, la colère ou la peur. La population évaluée dans les études de Kasari et al. et Porter et al. est plus jeune que celles de nos études (enfants d'âge moyen de 7 ans chez Kasari et al., et de 16 ans chez Porter et al.). En prenant en compte cet élément, nous pourrions suggérer qu'au cours du développement, les personnes avec SD vont de mieux en mieux différencier les catégories émotionnelles liées à ces expressions et commettre dès lors des erreurs plus subtiles. Le biais positif observé dans l'enfance pour l'émotion de joie évoluerait en fonction, s'affinant ainsi avec l'âge.

Toutefois, les divergences dans les résultats pourraient également être imputées à la différence des tâches et des expressions évaluées dans les études. On note ainsi que l'intensité des émotions n'a pas été évaluée dans les études menées auprès des enfants. Sa mesure offre une image plus précise de la façon dont les expressions sont traitées, et nous ne pouvons dès lors pas écarter l'hypothèse qu'un pattern de réponses plus nuancé ait été masqué chez les enfants avec SD. En outre, les études 1 et 2 n'ont examiné que l'expression de tristesse alors que celles menées auprès des enfants proposent également des items pour la colère et la peur. Si nos résultats démontrent un biais positif pour le traitement de la joie, de la tristesse et de l'état neutre, ce biais n'a pas pu être vérifié pour d'autres émotions à valence négative. Il se pourrait donc que des confusions s'opèrent également entre la joie et la colère ou entre la joie et la peur chez les adultes avec SD.

2.2 Traitement particulier des visages émotionnels

Dans l'étude 1, une relation positive et forte a été observée chez les adultes avec SD entre le score de biais émotionnel et une tâche d'inhibition verbale (tâche Jour-Nuit, Gerstadt et al., 1994), alors qu'aucune relation significative n'est apparue avec les autres mesures cognitives générales (raisonnement non verbal, vocabulaire réceptif, inhibition motrice) et l'âge chronologique. Nous avons ainsi suggéré que ce biais émotionnel pourrait reposer en partie sur des difficultés pour inhiber une tendance à répondre de manière positive face à des émotions faciales.

A la suite à ce résultat, nous avons voulu investiguer plus en détail la nature de cette relation entre les émotions faciales et les processus d'inhibition chez les adultes avec SD. Une de nos hypothèses était que les visages émotionnels, et plus particulièrement les visages de valence positive, constitueraient des stimuli très saillants pour les personnes avec SD et donc plus difficiles à inhiber. Dans ce cadre, nous avons proposé dans l'étude 3 une tâche basée sur la tâche de Stroop émotionnel[47], nous permettant d'explorer les capacités d'inhibition d'une réponse dominante sur un matériel à contenu émotionnel (un visage avec une expression de joie ou de tristesse) ou à contenu neutre (image d'une lune ou d'un soleil).

En ce qui concerne les temps de réponse des participants avec SD et des enfants au développement normal, nous avons observé un pattern similaire dans les deux groupes. Les stimuli émotionnels nécessitent plus de temps pour être traités que les stimuli neutres, et ce pour les deux conditions de la tâche (contrôle et inhibition). Ces résultats corroborent les données de la littérature ayant exploré l'influence d'images émotionnelles sur l'attention ; plusieurs études ont en effet montré que les stimuli émotionnels capturent davantage les ressources attentionnelles que les stimuli neutres (Buodo, Sarlo, & Palomba, 2002; Schimmack, 2005; Schulz et al., 2007; Verbruggen & De Houwer, 2007), avec pour conséquence l'interruption ou le ralentissement de l'activité en cours[48]. Dans une étude comparant les capacités d'inhibition de réponses automatisées à contenu émotionnel (visages heureux et tristes) et neutre (cercles de couleur rouge ou verte) auprès d'adultes sans troubles du développement, Schulz et al. (2007) suggèrent que les temps de réponse plus longs pour traiter les visages émotionnels seraient liés à la complexité de ces stimuli (reconnaissance du visage, perception de l'émotion), recrutant des ressources cognitives supplémentaires par rapport aux formes géométriques. Dans le cadre de notre étude 3, ces deux raisonnements (stimuli émotionnels plus saillants, visages émotionnels plus complexes) nous paraissent pertinents pour expliquer les résultats observés pour les stimuli émotionnels. N'étant par

[47] Pour rappel, la tâche de Stroop émotionnel permet d'évaluer l'influence de la valence émotionnelle des stimuli sur les processus d'inhibition, en comparant les temps de réponse obtenus avec des mots à contenu neutre ou émotionnel (le choix des stimuli se base sur l'objet de préoccupation de la population évaluée, par exemple les mots *poilu* et *rampant* pour des personnes souffrant d'arachnophobie). Dans ce type de tâche, un effet perturbateur lié au matériel émotionnel est généralement observé, cet effet d'interférence étant interprété comme un biais attentionnel lié à la saillance de ces stimuli (J. Williams et al., 1996). Toutefois, l'effet inverse peut être observé chez certaines personnes, le matériel émotionnel étant cette fois traité avec plus de rapidité que le matériel neutre. Cet effet facilitateur est interprété par certains auteurs comme un signe d'évitement de ces stimuli (Mathews & MacLeod, 1994).

[48] Plusieurs études rapportent que la réponse rapide du système face à des stimuli émotionnels est issue de l'évolution. Selon les tenants de la théorie des catégories négatives (categorical negativity theory), cette réaction aurait un grand avantage pour la survie, permettant de faire face très rapidement à des stimuli environnementaux déplaisants ou dangereux (Öhman, Flykt, & Esteves, 2001; Pratto & John, 1991).

ailleurs pas exclusifs, il est probable que ces facteurs aient une influence conjointe sur les temps de réponse de nos participants.

En ce qui concerne l'analyse des taux de réussite, nous avons noté que les adultes avec SD ont également plus de difficultés lorsqu'ils doivent traiter les stimuli émotionnels dans la condition d'inhibition. Ils commettent ainsi davantage d'erreurs dans la tâche Content-Triste (taux de réussite de 70%) que dans la tâche Soleil-Lune (taux de réussite proche de 90%). Contrairement aux résultats observés pour les temps de réponse, le pattern de réponse des enfants au développement normal est cette fois différent de celui des adultes avec SD. Les enfants de contrôle obtiennent des taux de réussite avoisinant les 90% dans les deux tâches, indiquant que les difficultés constatées dans la tâche Content-Triste sont spécifiques aux participants avec SD. Dans les études proposant une tâche de Stroop émotionnel, les taux d'erreurs sont généralement très faibles, raison pour laquelle seuls les temps de réponse sont analysés et interprétés. Nous pouvons toutefois tenter d'interpréter les résultats des adultes avec SD en réfléchissant à partir des explications fournies par la littérature sur les temps de réponse. Les visages émotionnels seraient ainsi, pour les personnes avec SD, des stimuli particulièrement saillants, qui entreraient en interférence avec la demande de la tâche. Cette observation peut également être faite chez les enfants du groupe de contrôle (leurs temps de réponse sont plus lents pour les stimuli émotionnels que les stimuli neutres). Cependant, l'effet d'interférence serait plus important chez les adultes avec SD, ces derniers n'ayant plus assez de ressources cognitives pour inhiber la réponse dominante.

Dans ce cadre, nous pourrions nous attendre à ce que la valence émotionnelle des stimuli ait une influence sur la réussite de la tâche. Nous avons en effet observé dans les études 1 et 2 que les adultes avec SD présentent un biais de positivité dans leur évaluation des expressions faciales. Nous avons ainsi émis l'hypothèse que dans la tâche Content-Triste les items montrant un visage heureux pourraient être plus difficiles à inhiber que les items montrant un visage triste, les stimuli de joie captant davantage l'attention des adultes avec SD et rendant de ce fait la tâche plus difficile. Toutefois, ces résultats n'ont pas été confirmés, les analyses révélant que les performances des adultes avec SD sont similaires pour les visages joyeux et tristes (taux de réussite et temps de réponse). Une explication possible de ce résultat peut être proposée en regardant de plus près le biais observé chez les personnes avec SD. Le biais positif pour le jugement des émotions ne repose pas uniquement sur l'amplification de l'émotion de joie ; le jugement de la tristesse est également biaisé, cette émotion étant atténuée par les adultes avec SD. L'expression faciale de tristesse semble donc revêtir une importance particulière chez les personnes avec SD. La présentation d'un visage triste

pourrait ainsi entraîner un effet d'interférence similaire à celle d'un visage joyeux. En d'autres termes, tant des émotions de valence positive que des émotions de valence négative auraient une influence sur les réponses des participants.

Il nous paraît intéressant de relever que les similarités observées dans le traitement des stimuli joyeux et tristes se rapproche de résultats retrouvés auprès d'adultes sans troubles du développement dans des études examinant l'influence d'images émotionnelles sur les processus attentionnels et d'inhibition (Constantine et al., 2001; Schimmack, 2005; Verbruggen & De Houwer, 2007). Ces études soutiennent la théorie de l'activation émotionnelle (*arousal theory*), qui avance que tout stimulus émotionnel de forte intensité va capturer l'attention d'une personne, indépendamment de sa valence. Dans ce cadre, le profil de réponses des adultes avec SD suivrait une trajectoire normale, mais exacerbée. Face à des visages émotionnels, les personnes avec SD se montreraient ainsi plus sensibles et réactives. Cette plus grande réactivité face à des visages émotionnels pourrait être mise en lien avec l'intérêt particulier que ces personnes démontrent pour les partenaires sociaux durant leur enfance. Nous avons vu dans l'introduction théorique que les enfants avec SD cherchent activement à entrer en interaction et qu'ils ont une préférence marquée pour regarder les personnes par rapport aux objets. A l'entrée dans l'adolescence, les personnes avec SD vont développer une tendance à se renfermer sur eux-mêmes, pour des raisons qui comme nous l'avons vu restent difficiles à saisir. Mais malgré leur changement d'attitude, il est fort probable que les adultes avec SD restent très intéressés par autrui. Cette hypothèse semble par ailleurs être confirmée par certaines conduites qu'on relève chez les adultes dont le comportement socio-émotionnel est décrit par les éducateurs comme étant en retrait. Sous certaines conditions (personne jugée attractive par exemple), ces adultes peuvent se montrer très enthousiastes pour entrer en relation, d'une manière souvent inadéquate (rapprochement excessif, élans de tendresse non contrôlés et non adaptés à la situation). Ce type de comportement pourrait en partie reposer sur des difficultés plus fondamentales à réagir de manière maîtrisée face à une personne provoquant des émotions intenses. Il serait ainsi intéressant de voir si les adultes avec SD qui réussissent moins bien la tâche Content-Triste (et donc plus sensibles aux visages émotionnels) présentent plus de difficultés au niveau de leur comportement socio-émotionnel.

2.3 Attribution d'une expression selon un contexte social : profil de réponses spécifique

Nous nous proposons maintenant d'examiner les résultats de la deuxième expérience de l'étude 2, et qui s'est intéressée aux capacités d'attribution d'une expression faciale en

fonction d'un contexte. Les résultats principaux ont révélé que les participants avec SD présentent un déficit particulier pour attribuer l'émotion de tristesse, alors que leurs performances sont similaires à celles des enfants de contrôle pour les items suscitant la joie, la colère et la peur. Dans les deux groupes, les résultats obtenus pour la joie sont supérieurs à ceux obtenus pour les trois autres émotions, ces différences restant toutefois non significatives (à l'exception de l'émotion de peur pour le groupe de contrôle).

Ces résultats se distinguent ainsi des données rapportées dans la littérature portant sur les enfants avec SD, où les performances des participants avec SD sont généralement inférieures à celles des enfants de contrôle (Kasari et al., 2001; Turk & Cornish, 1998), avec des difficultés notamment pour l'attribution des expressions de colère et de peur (Kasari et al., 2001). Comme souligné dans la partie introductive du présent travail, il est délicat de comparer ces différentes études du fait de la variété des paradigmes qui ont été utilisés (images, histoires, poupées). Toutefois, les résultats obtenus dans l'étude 2 suggèrent que les adultes avec SD seraient plus compétents que les enfants pour attribuer une émotion faciale à un contexte. De ce fait, et contrairement aux hypothèses émises dans la littérature chez les enfants avec SD, les personnes avec SD pourraient encore progresser après l'adolescence dans certains domaines relatifs au traitement des émotions.

Nous possédons certaines informations sur les compétences d'attribution des émotions chez les adultes avec SD, ces dernières ayant été évaluées dans l'étude de Smith et Dodson (1996) au moyen de vignettes vidéos suscitant les émotions de joie, tristesse, ou aucune émotion en particulier. Les résultats de cette étude indiquent que les adultes avec SD réussissent mieux les items de joie, suivis par ceux de tristesse et finalement les items neutres. Toutefois, l'absence de comparaisons statistiques entre les différents scores (entre les deux groupes mais également à l'intérieur des groupes) ne permet malheureusement pas d'aller au-delà d'observations qualitatives. Il aurait été intéressant de pouvoir plus précisément situer les performances des adultes avec SD, et ce notamment pour l'émotion de tristesse.

Dans l'étude 2, nous avons en effet constaté chez les participants avec SD d'importantes difficultés pour attribuer l'émotion de tristesse, difficultés auxquelles nous ne nous attendions pas. Les adultes avec SD n'ont démontré aucun déficit dans les épreuves de reconnaissance de cette émotion (études 1 et 2). En outre, les données de la littérature développementale ne relèvent pas de difficultés spécifiques pour l'attribution de cette émotion par rapport aux autres émotions dites « de base » (réussite entre l'âge de 4 et 6 ans selon les études, Camras et Allison, 1985 ; Denham, 1986 ; Pons et al., 2004). Les résultats des analyses corrélationnelles menées entre le taux de réussite pour l'attribution de la tristesse et

les compétences cognitives générales (raisonnement non verbal, vocabulaire réceptif, attention sélective) fournissent toutefois des éléments de réponse intéressants. Une relation positive et relativement forte a été observée avec la mesure d'attention sélective (également retrouvée dans le groupe de contrôle). Une interprétation possible de ce résultat serait donc que les participants qui analysent moins bien l'image, ne repéreraient pas l'élément cible induisant la tristesse[49].

Chez les adultes avec SD, il semble toutefois que ces problèmes pour attribuer la tristesse ne reposeraient pas uniquement sur des difficultés d'attention visuelle. Une relation positive et d'importance a également été notée entre le score pour l'émotion de tristesse et le score global dans la tâche d'appariement des expressions faciales, et ce uniquement pour le groupe avec SD. Nous avons vu dans les études 1 et 2 que les performances des participants avec SD sont très faibles dans cette tâche d'appariement en comparaison aux tâches d'identification et de discrimination ; l'hypothèse a ainsi été émise que cette tâche exigerait un niveau de compréhension des émotions plus élevé pour être réussie. Ainsi, la relation observée avec la tâche d'appariement suggère que l'émotion de tristesse serait plus difficile à attribuer pour les participants avec SD en comparaison aux émotions de joie, peur et colère. Par ailleurs, cette hypothèse est soutenue par l'absence de relations significatives entre ces trois émotions dans la tâche d'attribution et les épreuves de reconnaissance des expressions faciales.

L'analyse de l'ensemble des réponses données par les adultes avec SD dans l'épreuve d'attribution amène de nouveaux éléments permettant de mieux saisir leurs difficultés relatives à l'émotion de tristesse. On relève en effet que cette émotion est très peu sélectionnée par les participants avec SD tout au long de l'épreuve, et que le taux de mauvaises réponses impliquant la tristesse est significativement plus faible dans ce groupe que chez les enfants de contrôle. Ce pattern est en outre spécifique à la tristesse, les taux d'erreurs dans le groupe avec SD pour les autres émotions de valence négative étant équivalents (colère) ou supérieurs (peur) à ceux du groupe de contrôle. A partir de ces résultats, nous pouvons émettre l'hypothèse que les participants avec SD éviteraient délibérément d'attribuer la tristesse, révélant chez ces personnes un nouveau biais dans le traitement des émotions. Un rapprochement peut par ailleurs être fait entre ce biais pour l'attribution de la tristesse et le biais de positivité observé dans les études 1 et 2 dans la tâche

[49] Cette hypothèse est soutenue par des observations réalisées au cours des passations. Pour exemple, nous avons remarqué que plusieurs participants des deux groupes ont attribué l'émotion de joie dans un item qui représente le personnage principal assis dans une prairie fleurie, un oiseau blessé se trouvant pourtant à quelque distance de lui.

de discrimination des expressions faciales. Il semblerait ainsi que les adultes avec SD traitent de manière particulière l'émotion de tristesse, évitant son attribution et minimisant son intensité.

Compte tenu de la nature du biais de positivité retrouvé dans la tâche de discrimination (minimisation de la tristesse mais également amplification de la joie), nous aurions pu nous attendre à ce que les adultes avec SD attribuent plus souvent l'expression de joie dans cette épreuve. Cependant, si le taux d'erreurs pour la joie est effectivement plus élevé que ceux pour la colère et le neutre, il ne se distingue pas significativement du taux d'erreurs pour la peur. Nous pensons toutefois que ces résultats ont pu être influencés par l'usage de l'expression neutre en tant que distracteur dans cette épreuve. Comme nous l'avons vu dans les études 1 et 2, la reconnaissance de l'expression neutre est très déficitaire chez les adultes avec SD. En outre, ces personnes ont montré une tendance à considérer les visages neutres comme joyeux. Dans ces conditions, il est probable que certains participants avec SD aient sélectionné l'expression neutre par erreur, la confondant avec celle de joie. Nos observations lors des passations appuient ce scénario, plusieurs participants nous disant que le personnage était content dans une situation, quand bien même ils venaient d'attribuer le visage neutre à cet item. Ces constats remettent en question l'intérêt de proposer un distracteur neutre dans cette tâche puisque plusieurs adultes avec SD ont montré des difficultés à le reconnaître au cours de l'évaluation. Ce stimulus neutre pourrait ainsi avoir biaisé les patterns de réponses, et il serait pour ces raisons plus pertinent de le supprimer dans les études à venir. Ce faisant, des changements pourraient apparaître dans le profil de réponses des adultes avec SD, avec notamment une augmentation du taux de réussite pour la joie et davantage d'erreurs impliquant cette émotion.

Au sein de la tâche d'attribution, il nous semble enfin intéressant de mettre en lumière les résultats obtenus par les adultes avec SD pour la peur. C'est en effet la seule émotion pour laquelle les adultes avec SD obtiennent une performance légèrement supérieure à celle de leur groupe de contrôle. Compte tenu des données de la littérature sur les enfants avec SD, nous nous serions plutôt attendues à des performances déficitaires pour cette expression. En effet, la majorité des études menées chez les personnes avec SD ont rapporté des difficultés dans le traitement de la peur (Kasari et al., 2001; Porter et al., 2007; K. Williams et al., 2005; Wishart et al., 2007; Wishart & Pitcairn, 2000). En outre, les études développementales montrent que cette émotion est reconnue plus tardivement chez les enfants (vers l'âge de 5-6 ans), qui la confondent souvent avec d'autres émotions négatives comme la colère ou la tristesse (Bullock & Russell, 1986; Widen & Russell, 2003). Les analyses corrélationnelles n'ont pas montré de

relations significatives entre le taux de réussite pour ces items et les mesures cognitives générales, émotionnelles ou l'âge chronologique dans le groupe avec SD. Nous pourrions par contre suggérer un lien entre ces résultats et l'expérience de vie des adultes, où les situations à risque (par exemple trafic routier, personnes étrangères voulant entrer en contact) sont objets de fréquentes discussions avec l'entourage. Cette expérience permettrait aux adultes de reconnaître relativement facilement les situations de la tâche d'attribution qui vont susciter la peur (items illustrant par exemple un accident de vélo, un chien à l'air menaçant). Toutefois, nous n'avons pas les moyens de vérifier cette hypothèse dans notre étude. Pour ce faire, une possibilité serait de conduire des études explorant les compétences d'attribution des émotions auprès de populations d'adultes avec une DI d'autre origine afin de voir si ces personnes obtiennent des performances comparables au groupe d'adultes avec SD. Par ailleurs, la comparaison de groupes d'enfants et d'adultes avec SD pourrait également nous renseigner sur l'influence de l'expérience de vie sur ces compétences.

Concernant l'émotion de peur, il nous paraît enfin important de souligner une des limites des études 1 et 2, qui est de ne pas avoir évalué la reconnaissance de cette émotion. Les recherches menées auprès des enfants avec SD ont en effet relevé des difficultés importantes pour le traitement de cette émotion, et il aurait été intéressant d'examiner si ces difficultés se maintiennent à l'âge adulte. Dans la tâche d'attribution de l'étude 2, nous avons noté que les visages schématisés représentant la peur étaient facilement reconnus par les adultes avec SD, cette observation soutenant l'hypothèse d'une progression dans la reconnaissance de cette émotion avec l'âge. Toutefois, les stimuli présentant des photographies de visages pourraient se révéler plus difficiles à traiter pour la population avec SD (traits émotionnels moins marqués en comparaison aux dessins schématisés). Il serait ainsi également intéressant de vérifier l'impact du support émotionnel sur les performances des participants.

2.4 Modèle intégratif du traitement des expressions faciales chez les adultes avec SD

Comme cela a été souligné dans la partie introductive de ce travail, les études ayant exploré la reconnaissance et l'attribution des émotions faciales dans la population avec SD rencontrent des difficultés pour comprendre l'origine des déficits retrouvés chez leurs participants. Une part importante du problème peut s'expliquer par le fait que seules les études les plus récentes ont évalué d'autres mesures cognitives générales dans leurs populations, en plus des compétences émotionnelles (Porter et al., 2007; K. Williams et al.,

2005; Wishart et al., 2007). En outre, on déplore l'absence de modèles théoriques qui permettraient de fournir un support pour interpréter les résultats.

Les études 1 et 2 de notre travail se sont penchées sur les capacités de reconnaissance et d'attribution des expressions faciales chez les adultes avec SD, mais également sur les relations entre ces compétences émotionnelles et différentes mesures cognitives générales. L'étude 3 a exploré plus particulièrement la manière dont les personnes avec SD appréhendent les visages émotionnels au moyen d'une tâche d'inhibition de réponse dominante. Nous avons tenté dans la Figure 2 d'intégrer l'ensemble de ces résultats au sein d'un modèle plus général, se centrant sur les différents processus en jeu lors du traitement des expressions faciales chez les adultes avec SD.

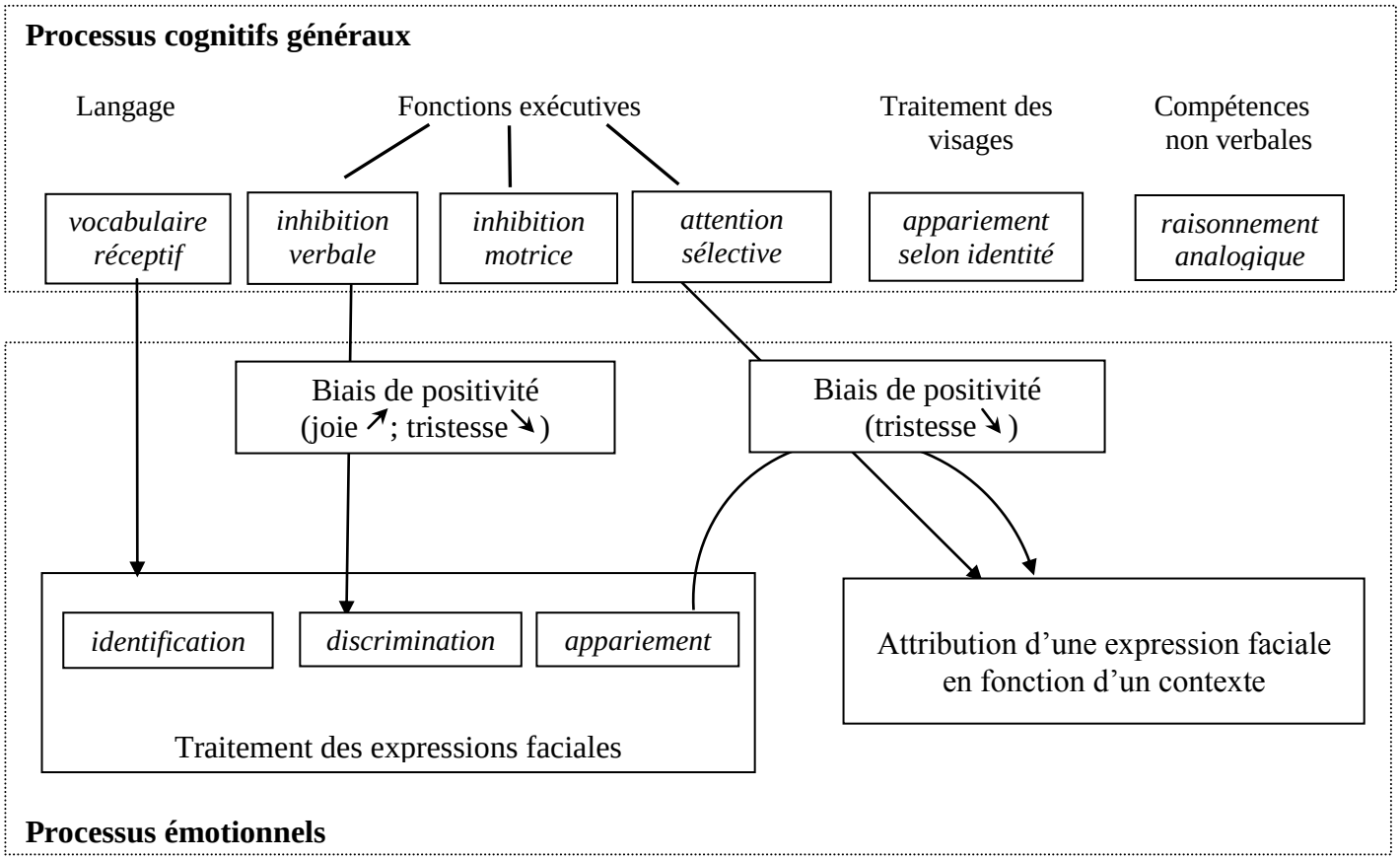

Figure 2. Modèle intégratif du traitement des expressions faciales chez les adultes avec SD

Dans ce travail, nous avons pris le parti de séparer les compétences de reconnaissance des expressions faciales des compétences d'attribution des expressions selon un contexte social. Ce choix a été motivé par le fait que les processus de traitement impliqués dans l'épreuve d'attribution paraissent plus complexes, nécessitant notamment la capacité de se mettre à la place d'autrui (une théorie de l'esprit) et la reconnaissance préalable des émotions à attribuer. Nous avons constaté qu'il y a très peu de relations entre les différentes tâches émotionnelles proposées ; une seule relation d'importance est apparue entre la tâche d'appariement des expressions et l'expression de tristesse dans la tâche d'attribution. Par ailleurs, les relations observées aves les processus cognitifs généraux sont différentes pour les compétences de reconnaissance des émotions et les compétences d'attribution.

Corroborant les résultats retrouvés dans plusieurs études chez les enfants avec SD (Turk & Cornish, 1998; K. Williams et al., 2005; Wishart et al., 2007), aucune relation significative n'a été relevée entre les capacités de traitement des visages, les compétences de raisonnement non verbal et l'ensemble des tâches émotionnelles administrées. Des différences sont par contre apparues dans les relations entretenues avec le langage. Dans les études 1 et 2, nous avons en effet noté des liens relativement forts entre le vocabulaire réceptif et les trois modalités de reconnaissance des expressions faciales, et nous avons émis l'hypothèse que la représentation des expressions à un niveau conceptuel jouerait un rôle très important dans la réussite de ces épreuves chez les adultes avec SD. Ce type de relations est par ailleurs retrouvé dans les études développementales (de Rosnay et al., 2008; Herba & Phillips, 2004; Pons et al., 2003). Contrairement à nos attentes, cette relation privilégiée avec le langage n'a pas été observée dans la tâche d'attribution des émotions, et ce pour les deux groupes. Si nous disposons de peu d'informations sur la nature des relations entre les capacités d'attribution des émotions et le langage chez les enfants au développement normal, nous avons vu dans l'introduction théorique que certains processus impliqués dans la réussite de cette tâche (reconnaissance des expressions, capacités à se mettre à la place d'autrui) sont fortement liés aux compétences langagières.

Certaines pistes peuvent être évoquées pour tenter d'expliquer cette absence de relations entre le langage et la capacité d'attribuer des émotions en fonction d'un contexte. Nous pouvons tout d'abord relever que les capacités de reconnaissance des expressions faciales ne semblent pas jouer un rôle essentiel dans la réussite de la tâche d'attribution, hypothèse qui est soutenue par le peu de relations retrouvées entre ces épreuves. Comme nous l'avons souligné plus haut dans la discussion, les dessins schématisés des expressions faciales présentés dans la tâche d'attribution sont facilement reconnus par les adultes avec SD ; les

processus cognitifs impliqués dans le traitement de ces stimuli (dessins schématisés versus photographies) pourraient ainsi différer. Par ailleurs, les situations émotionnelles exposées dans la tâche d'attribution pourraient faire appel à des compétences davantage liées au profil socio-émotionnel de la personne (basées sur ses expériences personnelles, ses capacités d'empathie) et reposeraient moins sur les capacités langagières.

Selon ce raisonnement, les capacités de reconnaissance et d'attribution des émotions faciales seraient donc bien différenciées chez les adultes avec SD, et évaluraient des aspects émotionnels relativement distincts. Il est cependant intéressant de relever qu'un profil cohérent émerge dans la manière dont ces personnes traitent les émotions au travers des différentes épreuves. Dans les études 1 et 2, un biais de positivité a ainsi été relevé dans le jugement des expressions faciales, l'intensité des visages joyeux étant augmentée et celle des visages tristes diminuée. Dans la deuxième partie de l'étude 2, nous avons observé une tendance à éviter d'attribuer l'émotion de tristesse à des contextes sociaux. Enfin, nous avons constaté dans l'étude 3 que les visages émotionnels présentant une émotion joyeuse et triste constituaient des stimuli particulièrement prégnants chez les personnes avec SD. Nous pouvons souligner que les biais mis à jour dans les études 1 et 2 apparaissent par ailleurs liés à deux composantes exécutives. Dans l'étude 1, nous avons ainsi retrouvé un lien positif et fort entre les capacités d'inhibition verbale et le score de biais de réponses. Dans l'étude 2, nous avons relevé une relation entre l'attention sélective et les capacités d'attribution émotionnelle pour la tristesse. Les spécificités retrouvées dans les processus de traitement des émotions pourraient ainsi découler de difficultés plus fondamentales au niveau des processus exécutifs.

Enfin, il est important de souligner que le modèle présenté ici constitue un premier effort pour intégrer le profil des compétences observées dans la reconnaissance et à l'attribution des émotions faciales chez les adultes avec SD, et ne peut être considéré comme exhaustif. Son objectif est de proposer une synthèse intégrée des résultats, et d'autres travaux seront nécessaires afin de vérifier les relations mises à jour dans nos études et affiner les processus impliqués. Comme nous l'avons mentionné auparavant, plusieurs améliorations pourraient être apportées à l'évaluation des compétences émotionnelles examinées dans ce travail (inclusion de nouvelles émotions avec différents niveaux d'intensité, variations de matériel, etc.). En outre, il serait important d'explorer les relations avec certaines compétences cognitives qui n'ont pas été mesurées dans ces études, en proposant notamment une évaluation plus détaillée des capacités de compréhension langagière (se limitant ici au vocabulaire réceptif) et des capacités liées aux fonctions exécutives. L'introduction d'une mesure de l'attention divisée et de la flexibilité mentale nous paraîtrait particulièrement

pertinente pour la tâche d'attribution des émotions, qui nécessite, notamment, le traitement simultané de plusieurs stimuli.

Par ailleurs, les études de ce travail n'ont pas exploré les relations entre les capacités de reconnaissance et d'attribution des émotions et le comportement socio-émotionnel. Nous avons vu dans l'introduction théorique que les études menées auprès des enfants avec SD n'ont pas observé de liens significatifs entre ces compétences émotionnelles et l'échelle de comportement Vineland (Turk & Cornish, 1998; K. Williams et al., 2005; Wishart et al., 2007). Toutefois, il est possible que des liens soient mis à jour en utilisant une batterie d'évaluation des émotions plus large, et en appliquant d'autres échelles examinant le fonctionnement socio-émotionnel chez les adultes avec SD. Comme nous en avons discuté auparavant, les particularités observées chez les personnes avec SD dans la reconnaissance des émotions et le traitement des visages émotionnels pourraient leur porter préjudice dans l'établissement et le maintien de relations sociales. Il serait ainsi intéressant d'examiner dans de futurs travaux ces liens de façon plus spécifique en regardant si des relations apparaissent entre des échelles évaluant le fonctionnement socio-émotionnel et les scores obtenus dans les tâches émotionnelles.

2.5 Capacités de raisonnement social

Comme nous l'avons vu dans le chapitre 3 de l'introduction théorique, aucune étude ne s'est penchée sur les capacités de raisonnement social dans le SD. Nous avons ainsi présenté une revue de la littérature portant sur un domaine relativement proche, celui de la théorie de l'esprit, et qui a montré que les paradigmes classiques relatifs à ces compétences sont en fait peu adaptés à la population avec SD. En effet, la majorité de ces tâches nécessitent un relativement bon niveau de compétences langagières et mnésiques, alors que les personnes avec SD présentent des difficultés importantes dans ces deux domaines. Les déficits observés dans cette population s'avèrent dès lors difficiles à interpréter. Dans l'étude 4, nous avons ainsi proposé d'aborder la manière dont les adultes avec SD appréhendent et comprennent les comportements d'autrui en utilisant une tâche de raisonnement social (Barisnikov et al., 2005), qui a été spécifiquement développée pour évaluer des personnes avec un niveau de DI léger et modéré.

Les résultats globaux ont montré que les adultes avec SD réussissent cette épreuve aussi bien que les enfants de contrôle. Toutefois, des différences apparaissent entre les groupes lorsque l'on regarde les patterns de réponses plus en détail. Si aucune différence significative n'est retrouvée pour l'évaluation des situations sociales appropriées, les

participants avec SD ont plus de difficultés à juger les situations inappropriées, ainsi qu'à repérer l'élément critique de la situation par rapport aux enfants au développement normal. Cependant, leur compréhension globale pour les items jugés de manière adéquate comme inappropriés est équivalente à celle des enfants de contrôle. Ce résultat, qui paraît au premier abord paradoxal, s'explique par des différences retrouvées dans la qualité des réponses justificatives proposées par les deux groupes. Comparés aux adultes avec SD, les enfants du groupe de contrôle fournissent un plus grand nombre d'explications incorrectes ou n'ont pas de réponses du tout à proposer (« *je ne sais pas* »). Par contre, les niveaux de réponses des deux groupes ne se distinguent pas quand l'explication est correcte ; les enfants de contrôle et les adultes avec SD proposent autant de réponses situées à un niveau factuel (description de la situation inappropriée) que de réponses situées à un niveau intersubjectif (prise de position en lien avec la conscience sociale et morale). Enfin, aucune réponse n'atteint le niveau conceptuel (connaissance des concepts sur lesquels reposent les règles sociales et morales) pour l'ensemble des participants (à l'exception d'une réponse d'un adulte avec SD).

Concernant les adultes avec SD, il est intéressant de noter que des réponses évaluées comme incorrectes reviennent plus fréquemment dans certains items, et peuvent trouver du sens dans le quotidien de ces personnes. On peut citer en exemple les réponses données pour l'item présentant deux filles côte à côte, l'une mangeant des pop-corn, l'autre la regardant avec envie : « *ce n'est pas bien, il faut pas manger ces cochonneries, ça fait grossir* », « *c'est pas bon pour le régime ça* ». Des réponses du même type sont également retrouvées pour l'item représentant cette fois une situation appropriée, où une dame distribue du gâteau à des personnes assises autours d'une table. Nous savons que les problèmes de poids sont très fréquents chez les adultes avec SD, et plusieurs d'entre eux sont surveillés de près par leurs éducateurs et leur famille. Ce type de réponses peut donc traduire le vécu des participants, qui vont se projeter dans le personnage qui mange du pop-corn, ou dans les personnes qui s'apprêtent à manger le gâteau. Cette observation soulève l'hypothèse d'un biais attentionnel pour un stimulus de nourriture à connotation interdite chez ces participants. En effet, ce stimulus semble primer sur l'interaction représentée entre les personnages. Il serait intéressant de regarder si les réponses de ces participants pourraient être recentrées sur les interactions sociales en remplaçant les pop-corn ou le gâteau par des objets de consommation « autorisés » (par exemple des fruits) ou des objets n'étant pas en lien avec la nourriture.

Les résultats obtenus par les participants avec SD dans l'étude 4 révèlent un niveau de compréhension des interactions sociales relativement bon par rapport à celui des enfants au développement normal. Par ailleurs, même s'il est difficile de comparer cette tâche avec les

paradigmes classiques évaluant la théorie de l'esprit, on peut toutefois relever que les capacités à se mettre à la place d'autrui semblent être bien meilleures chez les adultes avec SD dans une tâche impliquant des situations sociales en comparaison à des tâches impliquant des fausses croyances liées à la localisation d'un objet (Abbeduto et al., 2001; Yirmiya et al., 1996; Zelazo, Burack et al., 1996). Comme nous l'avons souligné auparavant, ces paradigmes classiques ne sont pas adaptés pour la population avec SD, et renvoient à notre avis l'image d'un profil de compétences plus faible qu'il ne l'est en réalité.

Les performances des participants avec SD dans l'étude 4 peuvent être mises en lien avec leurs expériences de vie. Les situations sociales présentées dans la tâche apparaissent effectivement proches de leur quotidien (attendre son tour à l'office de poste, se répartir les tâches), et l'importance de respecter les règles illustrées dans certains items fait certainement l'objet de discussions fréquentes au sein des ateliers et structures d'accueil (faire attention à ce qui appartient à autrui, respecter l'intimité de chacun). Les réponses incorrectes, citées plus haut, se rapportant aux préoccupations de poids et de régime alimentaire soutiennent également l'idée que les participants font appel à leur propre vécu lorsqu'ils répondent à la tâche. Relevons par ailleurs que les explications des participants restent souvent au niveau des interdits (« *ça ne se fait pas* », « *on ne doit pas* », « *c'est mal de faire ça* »), et qu'ils ne donnent pas la règle impliquée dans la situation. Toutefois, nous avons vu dans l'introduction théorique que ce type de raisonnement plus mature (raisonnements conventionnels et postconventionnels selon Kohlberg, 1969) est observé tardivement dans le développement, vers la fin de l'adolescence.

2.5.1 Relations entre le raisonnement social, les compétences cognitives générales et le profil socio-relationnel

La tâche proposée dans l'étude 4 peut être considérée comme relativement complexe pour les adultes avec SD (traiter une image comportant différents stimuli, sélectionner les éléments les plus pertinents, élaborer son raisonnement sous la forme d'une réponse verbale), et nous avons contrôlé plusieurs compétences cognitives générales susceptibles d'avoir un impact sur sa réussite. En outre, les relations potentielles entre les capacités de raisonnement social et le profil du comportement socio-émotionnel ont été explorées chez les adultes avec SD à l'aide de l'échelle *Developmental Behaviour Checklist* (DBC, Einfeld & Tonge, 2002) remplie par leurs éducateurs référents. Les analyses corrélationnelles et de régression réalisées ont mis en évidence des relations spécifiques entre les capacités de raisonnement social et les différentes mesures cognitives et comportementales. Nous nous proposons de récapituler ces

résultats dans la figure 3. Les trois flèches en traits pleins indiquent les prédicteurs du score global à la tâche de raisonnement social, les flèches en traits-tillés, les corrélations significatives.

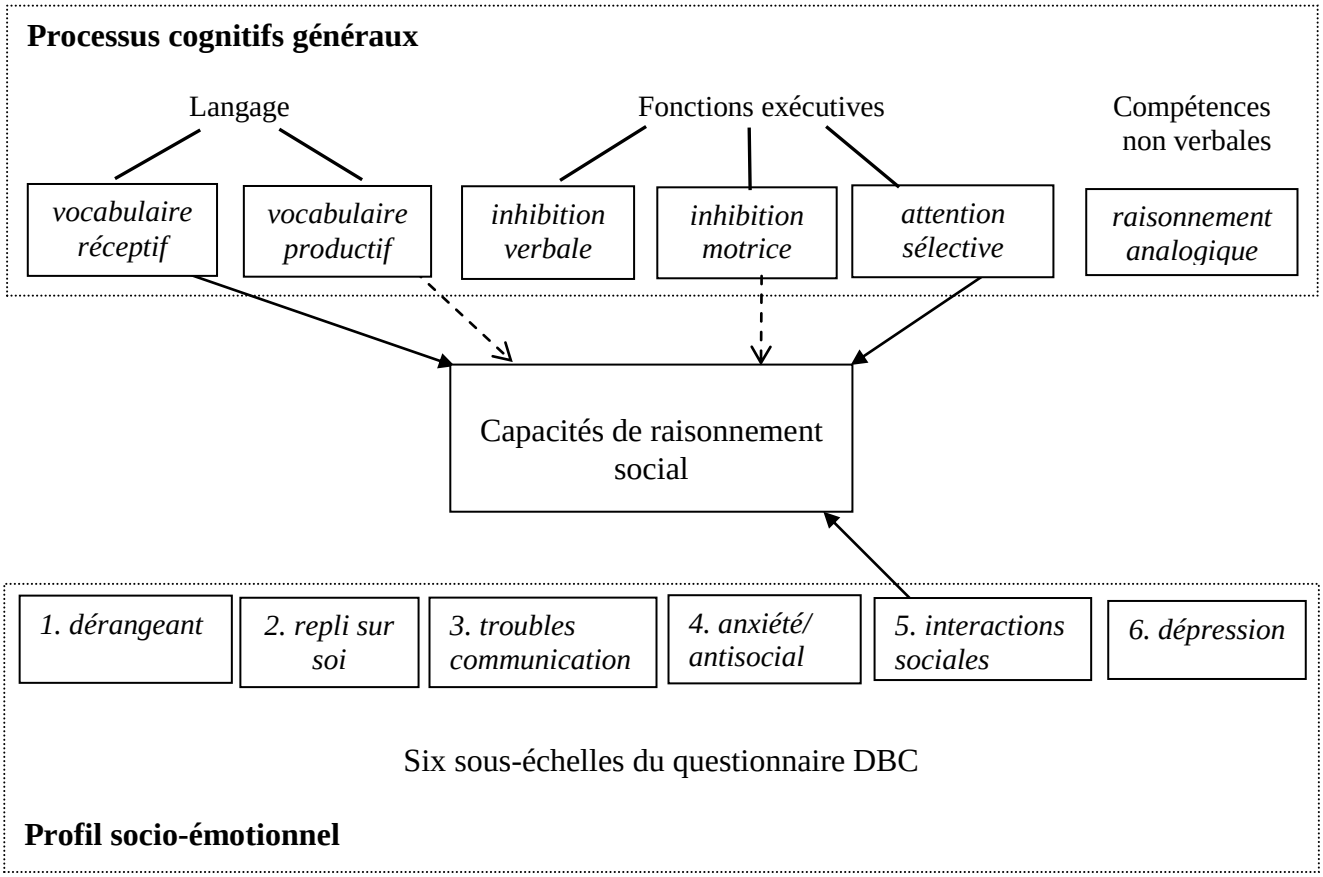

Figure 3. Représentation des liens observés chez les adultes avec SD entre le raisonnement social, les compétences cognitives générales et le profil socio-émotionnel

Nous avons relevé des relations entre les mesures langagières et les capacités de raisonnement social chez les adultes avec SD. Si ces liens étaient effectivement attendus au vu des compétences langagières engagées dans la tâche, il a été observé que les capacités de vocabulaire réceptif jouent un rôle prépondérant par rapport aux capacités de vocabulaire productif. Ce résultat nous semble d'une importance particulière puisque l'on sait que dans le SD, le versant productif du langage est souvent beaucoup plus déficitaire que le versant perceptif (Chapman, 1999b; Miller, 1999). Nous aurions ainsi pu craindre que certains participants se retrouvent en échec non pas du fait d'un raisonnement incorrect, mais de difficultés à exprimer leur pensée. Ces résultats indiquent que les performances obtenues par les adultes avec SD dans cette épreuve de raisonnement social ne se fondent pas uniquement sur la nature verbale des réponses à fournir, mais que c'est plutôt la représentation conceptuelle de la situation sociale qui joue un rôle central dans sa réussite. Il est intéressant de noter qu'aucun lien n'est retrouvé entre le niveau de vocabulaire réceptif et cette épreuve chez les enfants de contrôle. Ces résultats suggèrent que les compétences en jeu pour réaliser la tâche de raisonnement social seraient en partie différentes dans les deux groupes. En ce qui concerne le rôle des capacités langagières dans la réussite de la tâche de raisonnement social, il nous faut toutefois relever les limites de notre évaluation langagière, au travers de deux épreuves lexicales uniquement. Afin de mieux comprendre l'impact de la composante langagière, il serait nécessaire de proposer des épreuves plus spécifiques et proches des mécanismes impliqués dans la tâche de raisonnement social (évaluation de la compréhension syntaxique, des compétences narratives). Il n'est pas exclu que dans ce cas, des relations avec le langage soient également observées chez les enfants au développement normal.

Au sein des processus exécutifs examinés, l'implication des compétences d'attention sélective dans la réussite de la tâche a été observée dans les deux groupes. Cette relation peut s'expliquer par les exigences de la tâche, où les participants doivent être capables d'analyser visuellement toute l'image, afin d'y repérer les éléments les plus pertinents sur lesquels leur raisonnement va se baser. Ainsi, les personnes qui explorent l'image de manière moins efficace ou incomplète se trouveront en difficulté dans la première partie de l'épreuve, où il faut rendre un jugement sur la justesse du comportement social. Dans le groupe avec SD, les compétences d'inhibition d'une réponse dominante (motrice et verbale) ont également été évaluées, et nous avons observé une relation positive entre l'inhibition d'une réponse motrice et le score de raisonnement social. Ce résultat suggère que la réussite à la tâche pourrait être compromise chez les participants répondant de manière plus impulsive et brûlant les étapes nécessaires pour traiter correctement la tâche (observer l'image avec attention, sélectionner

l'élément le plus pertinent, formuler une réponse). Il est cependant nécessaire de rester prudent dans cette interprétation, puisque le lien avec l'inhibition motrice reste relativement modeste en comparaison aux relations observées avec les compétences langagières et attentionnelles. Plus généralement, il nous paraîtrait utile d'évaluer dans de prochains travaux les compétences de planification, car il est possible que cette composante ait une influence non négligeable sur la réussite de cette épreuve.

Enfin, nous pouvons aborder la relation observée entre la dimension « interactions sociales » de l'échelle de comportement DBC et la tâche de raisonnement social. Ce résultat est de première importance puisqu'un lien direct a pu être mis à jour entre une mesure du comportement social, évaluée par l'entourage, et les capacités de raisonnement mesurées au travers d'une tâche de laboratoire. Comme il a été mentionné plus en avant dans ce travail, la sous-échelle « interaction sociale » réfère principalement à des attitudes d'évitement des contacts sociaux. Ainsi, les adultes se distinguant par une attitude de retrait démontrent de moins bonnes capacités de compréhension des interactions sociales par rapport à leurs pairs ne présentant pas ce type de comportements. A partir de ces résultats, nous avons émis l'hypothèse que les adultes ayant des difficultés à interpréter les interactions sociales choisiraient à dessein de se mettre en retrait pour éviter des situations qu'ils ne comprennent pas, et qu'ils ne peuvent pas facilement gérer. Nous pouvons ainsi suggérer que leurs déficits de raisonnement social vont les confronter à des difficultés avec les pairs et les éducateurs, lesquel réprouveront leur comportement sans qu'ils puissent en saisir véritablement les raisons. Pour exemple, une personne ne comprenant pas pourquoi il n'est pas permis de regarder les affaires des autres pourra être fortement réprimandée, alors que pour elle il n'y a rien de mal à regarder quelque chose qui lui paraît intéressant. Par un effet de cercle vicieux, les personnes préférant se mettre à l'écart vont manquer des opportunités d'apprendre et d'entraîner ces aptitudes sociales. Toutefois, le protocole expérimental proposé dans l'étude 4 ne nous permet pas de saisir l'origine de ces difficultés de raisonnement social chez ces adultes avec SD. Une piste liée au caractère plus ou moins empathique de la personne nous paraît plus particulièrement pertinente. Il serait ainsi intéressant d'explorer les relations entre le raisonnement social et des questionnaires évaluant l'empathie.

Dans l'ensemble, ces résultats ne peuvent pas être directement mis en lien avec les données de la littérature, puisqu'il n'existe pas, à notre connaissance, d'études similaires ayant porté sur une population avec SD. On peut cependant signaler quelques études menées auprès de populations avec DI d'autre origine (étiologie non spécifiée ou inconnue) ayant mis en avant des relations entre les facteurs d'agressivité et de moins bonnes capacités à

comprendre le comportement d'autrui (Basquill et al., 2004; van Nieuwenhuijzen et al., 2006; van Nieuwenhuijzen et al., 2009). Chez les adultes avec SD, la dimension « dérangeant » de l'échelle DBC, peut être rapportée à ce facteur d'agressivité (se réfère à des comportements injurieux, provocateurs, colériques). Toutefois, cette dimension n'est pas significativement liée à la tâche de raisonnement social, ce qui suggère que les personnes plus agressives connaîtraient, dans les faits, les règles régissant les interactions sociales, mais ne réguleraient pas leur comportement en conséquence. Il est cependant important de souligner que peu d'adultes ayant pris part à l'étude 4 présentaient des comportements agressifs, ce qui pourrait expliquer l'absence de relations dans nos résultats. Comme nous l'avons vu dans le chapitre introductif sur le profil du comportement socio-émotionnel et les problèmes de santé mentale dans le SD, ces comportements sont effectivement rares dans cette population, et nos résultats vont donc dans le sens de la littérature (Collacott et al., 1998; Mantry et al., 2008; Melville et al., 2008).

3 Perspectives cliniques

Différentes applications cliniques s'ouvrent à la suite de ces premières études sur les processus émotionnels et sociaux des adultes avec SD. Comme nous avons pu le constater dans la revue de la littérature traitant des compétences émotionnelles et sociales dans le SD, il existe très peu de travaux portant sur les adultes âgés entre 20 et 40 ans. Pourtant, cette population est largement représentée au sein des ateliers protégés et n'est pas exempte de difficultés. Si les adultes avec SD ont relativement peu de troubles psychopathologiques en comparaison à d'autres populations avec DI, leur entourage rapporte certaines conduites difficiles à gérer, telles que de l'entêtement, des comportements dérangeants et peu adéquats, une tendance au retrait social. En outre, nous avons vu que les adultes avec SD sont plus à risque de développer une démence de type Alzheimer. Les inquiétudes de voir apparaître des signes de vieillissement pathologique sont grandes chez les familles et les intervenants, alors que les moyens de prise en charge des personnes avec SD sont pour l'heure très restreints. Une connaissance approfondie des compétences cognitives et socio-émotionnelles se révèle essentielle pour suivre l'évolution de ces personnes, et permettre de faire la part des choses entre des difficultés passagères, des signes de vieillissement « naturel » ou des signes de déclin pathologique. Dans nos études, nous avons pris soin de sélectionner des adultes ne présentant pas de signes cliniques de démence, afin de ne pas introduire de biais dans les résultats. Si nous n'avons pas noté de relations significatives entre l'âge chronologique et le

niveau de performance des adultes avec SD dans les diverses épreuves administrées, il demeure toutefois difficile de pouvoir certifier qu'aucun des 80 participants ayant pris part à nos recherches ne se trouvait à un stade pré-clinique de la maladie d'Alzheimer.

De manière générale, les différents instruments utilisés dans les quatre études se sont révélés bien adaptés à notre population et ont permis d'obtenir un profil de leurs compétences cognitives, émotionnelles et sociales relativement précis. De plus, nous avons constaté l'importance d'évaluer la reconnaissance des émotions selon différentes modalités. Ces informations revêtent un caractère essentiel dans l'optique d'un travail de remédiation, permettant de repérer les aspects sur lesquels il faudra plus particulièrement travailler avec la personne, en tenant compte de ses forces et de ses faiblesses. Toutefois, nous avons insisté sur la nécessité de compléter l'évaluation avec d'autres épreuves afin de mieux cerner les compétences de nos participants. Il faut en outre souligner que tous les stimuli émotionnels et sociaux de nos études ont été présentés sous une forme statique. Afin de proposer un matériel plus écologique, il serait utile d'amener de nouveaux instruments présentant des stimuli dynamiques (matériel vidéo par exemple) adaptés à une population avec DI. Il est cependant important de relever que dans le cadre d'évaluations cliniques, il est difficile d'administrer une longue batterie de tests à ces personnes. La plupart d'entre elles sont en effet rapidement fatigables et sont susceptibles de se décourager face à des exigences trop importantes ainsi qu'à un rythme d'évaluation trop soutenu. Il serait ainsi ainsi plus pertinent de sélectionner les épreuves à administrer en fonction de la demande formulée par l'entourage de la personne, en proposant dans un deuxième temps des mesures plus spécifiques permettant de mieux comprendre la nature des problèmes.

Enfin, des perspectives intéressantes s'ouvrent au niveau de la prise en charge de ces personnes, domaine qui reste pour l'heure très peu abordé dans la littérature. Comme il a été relevé dans l'introduction théorique, nous n'avons connaissance que d'une seule étude ayant proposé un programme d'entraînement des compétences sociales chez les adultes avec SD (Soresi & Nota, 2000). Par ailleurs, cette étude n'a pas pris en compte les processus cognitifs et émotionnels spécifiquement impliqués dans les difficultés des personnes, se focalisant uniquement, de façon globale, sur les comportements socio-émotionnels problématiques. Ceci explique probablement, en partie du moins, pourquoi les personnes n'ont pas montré de progrès à la suite du programme.

Les quatre études de ce travail ont mis en évidence le rôle joué par certains processus cognitifs généraux dans le traitement des informations émotionnelles et sociales chez les adultes avec SD. Ainsi, l'impact des capacités de compréhension langagière dans la

reconnaissance des expressions faciales a été observé dans l'étude 1, résultat qui a été confirmé par la suite dans la première expérience de l'étude 2. L'étude 4 a quant à elle montré l'implication de ces compétences dans le raisonnement social. Ces résultats suggèrent qu'une remédiation de cet aspect langagier pourrait avoir un impact positif sur les compétences socio-émotionnelles des adultes avec SD. En outre, d'autres résultats retrouvés dans cette même étude montrent qu'il serait également pertinent de travailler sur la compréhension des situations sociales de ces personnes dans l'optique d'améliorer leur intégration dans la société.

A la suite de ces premiers travaux, la professeure Barisnikov et son équipe ont mis au point un programme pilote de remédiation des compétences de reconnaissance des émotions chez les adultes avec SD, dont les premiers résultats se sont montrés encourageants. Les équipes éducatives ont en effet rapporté des progrès chez les personnes ayant pris part au programme, notamment dans leurs interactions sociales au sein des ateliers. Cependant, de nombreuses étapes devront encore être franchies pour proposer des interventions ajustées au mieux aux besoins des participants. L'engouement des équipes éducatives pour ce type d'intervention est très fort, témoignant d'une volonté de faire progresser ces personnes et de leur offrir une meilleure qualité de vie. Dans ces conditions, nous avons de bons espoirs que des programmes voient le jour dans un futur proche, contribuant à une meilleure intégration sociale des personnes avec SD.

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