The Feasibility and Diagnostic Accuracy of Screening and Diagnostic Instruments for Autism Spectrum Disorders: An Investigation in Al-Shafallah Center for Children with Special Needs

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1. Abstract

There is a lack of research into the reliability and validity of diagnostic tools for Autism Spectrum Disorder (ASD) across different ethnic groups. This investigation examined ASD assessment tools used at Al-Shafallah Center to determine how successful they are for the diagnosis of ASD in Arab children, aged 9-11 years old, within the State of Qatar. Children previously diagnosed and treated for autism were assessed along with a control group of children, enabling the identification of false positives and false negatives. A battery of five ASD measurements was selected and administered to all children. The results indicate that this battery of ASD measurement tools has excellent classification ability for ASD in Arab children. The Stroop-like test performed particularly well with 100% accuracy and our results suggest that this test should be considered for all ASD assessments in Arab children. The influence of age and gender was also assessed and no influence of these covariates was reported upon the classification ability of the ASD measures in autistic Arab children. Overall this study demonstrates that the ASD measurement tools used at the Al-Shafallah Center are valid for their use in Arab children for the diagnosis of ASD.

2. Executive Summary

This project aimed to highlight the diagnostic capabilities and determine the sensitivity and specificity of the selected screening tools for the diagnosis of ASD. Most importantly we aimed to examine their validity for use with Arab children.

The main findings of this study demonstrate an excellent classification ability of the ASD measurement tools used at the Al-Shafallah Center and that they are valid for use with autistic Arab children aged 9-11 years old. These ASD measurement tools have high accuracy in differentiating between ASD and disorders with similar symptoms in Arab children, with the Stroop-like test performing optimally with 100% accuracy. If this result can be replicated in a larger cohort, this measurement should be recommended for all ASD assessments in Arab children. Although age and gender impacted upon the scores of control children, no effect of these variables was identified for autistic children. Therefore, scores obtained from the ASD assessment tools do not need to be adjusted for age and/or gender in autistic Arab children.

To conclude, this study demonstrates that the ASD measurement tools used at the Al-Al-Shafallah Center are valid for their use in Arab children for the diagnosis of ASD. Optimal cut-off points for the diagnosis of ASD were calculated for each ASD measurement tool and these thresholds can now be used as a reference for future studies. Future studies should seek to replicate these results in a larger sample population.

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3. Background

Making a diagnosis of Autism Spectrum Disorder (ASD) is complicated by the fact that the symptomology of autism can change considerably with age; symptoms seen during infancy may not necessary progress during the child's development as they grow older (Selfe, 2002). Research suggests that with age, autistic symptoms become more recognizable and therefore parent's awareness of issues related to autistic symptoms also elevates (Baraneck, 1999). What's more, ASD misdiagnosis can also occur due to similarities with other mental health disorders, this includes; Attention Deficit/Hyperactivity Disorder (ADHD), Obsessive Compulsive Disorder (OCD), Childhood Disintegrative Disorder, Bipolar Disorder, and Oppositional Defiant Disorder. This is particularly true for ADHD, as there are many overlapping symptoms with autism. Several studies and retrospective analyses indicate that better screening and diagnostic tools need to be developed for infants and young toddlers, as there is limited data regarding the misdiagnosis of autism in these populations. In Table 1, the differential diagnosis of autism is listed.

Table 1. ASD differential diagnosis and other co-existing conditions.

• Global Developmental Delay
• Intellectual Disability • Hearing Problems • Visual Impairment • Specific Language Disorders • Social Communication Disorder • Selective Mutism • Anxiety • Obsessive Compulsive Disorder • Reactive Attachment Disorder/Maltreatment • Lack of opportunity for interaction • Rett syndrome (if features of regression) • Epileptic encephalopathy

ASD can affect many personal attributes of a child: attention, behaviour, activity, motivation, thought, emotion and mood can all be impacted. Children with autism can also have challenging

behaviours, including self-injurious behaviour, aggressiveness, tantrums, and oppositional defiant disorder. These issues alone can be challenging for parents and yet they are on top of the common difficulties that arise when caring for children, such as food selection and sleep. Moreover, children with autism can also have physical and/or mental comorbidities, just as children without autism.

Around 70% of people with ASD are classified as having at least one other behavioural issue or mental health disorder. This demonstrates the importance of identifying co-morbidities in children and adults with ASD effectively and accurately. There are some suggestions put forward for individuals with high functioning autism, however this becomes increasingly difficult with the severity of ASD, and each case is likely to present their own unique problems. Table 2 below lists neurodevelopment and psychiatric disorders frequently linked to autism.

Table 2. Co-morbidities often linked to autism.

• Tourette Syndrome/Tic Disorder
• Dyspraxia/Developmental Coordination Disorder (DCD) • Dyslexia • Obsessive Compulsive Disorder (OCD) • Specific Phobias • Anxiety • Depression/Mood Disorder • Sleeping Difficulties • Feeding Difficulties and Food Selectivity • Toileting Difficulties And Constipation • Oppositional Defiant Disorder And Conduct Disorder • Self-Injurious Behavior

Diagnostic tools in autism are needed to guide interventions such as therapy or medication, and should consider the needs of each case and their families in terms of their impairment, strengths and skills. This extends to identifying family history, associated developmental issues that can negatively impact children with autism and other co-morbidities. Children with autism can also have significant issues in their communication and cognitive capabilities, this can further complicate the use of ASD diagnostic tools. In the UK, the NICE guidelines suggest that children or young adults

who are suspected to have autism should have readily available access to local multidisciplinary teams that can provide in-depth advice and help to formulate a profile for the individual.

There are standardized forms of assessments for ASD that have been reviewed by NICE guidelines. It is recommended that these assessments are conducted by experienced professionals trained to use these instruments. The same professionals should also utilise the results to make an accurate diagnosis and to plan intervention(s) for the patient. However, it is important to note that standardized instruments are not required for every case, but can assist in facilitating a diagnosis as they can provide a broader understanding of the patients experiences. Therefore, such tools are not recommended to be used in isolation. They are also known to be less reliable in younger age groups (below 2 years of age).

4. Introduction

The term 'misdiagnosis' is defined by Carter et al (2015) as the 'Incorrect diagnosis of a symptomatic person with a condition they do not have. For instance, an individual may be misdiagnosed with Malaria due to a fever that is actually caused by other factors. Misdiagnosing can have negative consequences mainly because individuals may receive incorrect treatment. Providing incorrect treatment exposes the patient to unnecessary potential side effects and it also increases the costs for the healthcare system (Carter et al., 2015). Misdiagnosis can occur at any stage in the child's development. For instance, early symptoms may be dismissed by healthcare providers as phases during development, and informing parents that the child will “grow out of it”. On the other hand, parents might not be alerted to a developmental problem until a later stage of the child's life due to a lack of knowledge or denial. Both instances are incorrect interpretations of the child's ASD symptoms and are likely to result in a delayed and/or incorrect diagnosis and resulting treatment (Volkmar et al., 1999).

Diagnosis of developmental disorders by professionals is based on the criteria within the Diagnostic and Statistical Manual of Mental Disorders (DSM). Prior to 2013, the DSM-IV diagnosed Autism syndrome as part of a group of disorders titled Pervasive Developmental Disorders (PDD). This categorical description of separate disorders was characterized by a developmental delay in

social and communication skills and also included other categories such as Asperger's Syndrome, Rett's Syndrome and Childhood Disintegrative Disorder (Lobar, 2016). The 5th edition of the DSM was released in 2013 and the umbrella term PDD was replaced by Autism Spectrum Disorder (ASD) and now puts emphasis on the wider spectrum of complex neurodevelopmental disorders. Instead of having a sum of several separate syndromes, the DSM-V includes Autism syndrome, Asperger syndrome, Rett's syndrome, Childhood Disintegrative Disorder and Pervasive Developmental Disorder-Not otherwise specified (PDD-NOS) as part of ASD (Association, 2013). The word "spectrum" within ASD refers to the broad variety of symptoms, behavioural appearance, abilities and severity of functional disability. According to the National Institute of Neurological Disorders and Stroke (NINDS, 2015), the common symptoms of ASD are social impairment and difficulties communicating and interacting with others, alongside characteristic, repetitive and abnormal behavioural patterns. Severity of ASD is determined based on the degree in which daily functioning is affected by the repetitive behavioural patterns, routine insistence and the impairment of social communication and interaction skills (NINDS, 2015).

5. Literature review

The diagnosis of ASD is based on the assessment of language and intellectual impairment and diagnosticians use the DSM-V criteria to evaluate ASD symptoms on a continuum ranging from mild to more severe. The symptoms, severity and behaviour of patients with ASD vary enormously; increasing the complexity of the diagnostic process (Association, 2013). Even the age at which children display symptoms of ASD varies widely (Volkmar et al., 1999). Sometimes infants display abnormal behaviour before the age of two, such as: lacking eye-contact, inability to babble with parents and extreme focus on certain objects. However, other children might develop normally as an infant, but start to display a lack of interest and ability in social interactions from the age of two onwards. The first complaints and concerns from parents around the age of 2 are usually inconsistent response or non-responsiveness and weak language development, but by the age of 5 official diagnostic criteria can be measured via communicative speech and IQ (Joshi, Percy, & Brown, 2002; Organization, 2017). Nevertheless, the DSM-V diagnostic criteria require presence of symptoms during early childhood, but it is problematic to determine and identify social inability at an early age as a skill might be absent but still develop at a later age (Lobar, 2016). Additional

challenges of an ASD diagnosis include the high rate of developmental and psychological comorbidities and that the way in which ASD symptoms present change over time (Levy & Mandell, 2009; Wing, Gould, & Gillberg, 2011). The above-mentioned complexities in diagnosing ASD increase the likelihood of misdiagnosis, which was demonstrated by Young and Rodi (2014) who found that 57% of 210 children who were diagnosed with autism under the DSM-IV criteria would not fit the diagnostic criteria of ASD in DSM-V.

Furthermore, the common symptoms of ASD can be misinterpreted for other developmental disorders; for example, hindered speech development, no responsiveness and behavioural difficulties in young children can be misdiagnosed as language impairment or ADHD. Repetitive behavioural patterns in older children can also be misdiagnosed as OCD instead of autism (Mandell, Ittenbach, Levy, & Pinto-Martin, 2007). Moreover, an initial diagnosis of severe intellectual disability might overpower the diagnostician's requirement to further assess the child for developmental delays which can lead to misdiagnosis (Mandell et al., 2009). A study by Baudino revealed that children who have histories of abuse or neglect are likely to display autistic features and defences to protect themselves and keep others at safe distance; hence, many of these children are misdiagnosed with ASD (Baudino, 2010). Statistics show that females are less likely to be diagnosed with ASD and are more likely to be misdiagnosed with another mental health disorder. Social-cultural aspects have an important influence on the interpretation of ASD symptoms and displayed behaviour in females. For instance, gender-based expectancies and biases of female behaviour often leads to interpretation social difficulties as “just being shy”, which is perceived as normal for girls (Lai, Lombardo, Auyeung, Chakrabarti, & Baron-Cohen, 2015; Rivet & Matson, 2011). Furthermore, co-morbid conditions such as anxiety or depression in females often overshadow the symptoms of ASD and might result in a misdiagnosis of borderline or personality disorder (Trubanova, Donlon, Kreiser, Ollendick, & White, 2014). In conclusion, the absence of professional guidelines on initial screening and proper diagnostic measurement tools increase the probability for misdiagnosing ASD (Joshi, Percy & Brown, 2002).

6. Problem Statement

The role of cultural diversity in the diagnosis, perception and treatment of autism is

important to consider in order to further understand the prognosis and intervention of this mental health illness. Yet, there is a lack of research that has been conducted in Arab cultures in comparison to Western cultures (Freeth, Milne, Sheppard, & Ramachandran, 2014). Accordingly, the prevalence autism in Arabic cultures is lower than expected, mostly due to the difficulties in diagnosing children with ASD and a high occurrence of misdiagnosis (Taha & Hussein, 2014). In the UEA there is a lack of knowledge and education on the early symptoms of autism among healthcare professionals, which facilitates misdiagnosis. Misdiagnosis can prevent children with autism from receiving the correct services specifically developed to address their needs (Mahmoud, 2017). Despite the high levels of care towards children with mental disabilities among the Arab culture (Taha & Hussein, 2014), children with autism and their relatives often face socially stigmatized judgements due to the lack of understanding and misinformation given by healthcare professionals (Al Khandari, 2006). It is therefore essential to increase awareness, reduce stigma and improve professional education and knowledge in the Gulf region to provide effective intervention and reduce misdiagnosis of Autism.

7. Research Questions

The following research questions are considered:

- Are the ASD measurement tools used at the Al-Shafallah Center valid for use with Arab children?
- How accurate are these ASD measurement tools in differentiating between ASD and disorders with similar symptoms?
- Should scores obtained from the ASD assessment tools be adjusted for age and/or gender?

8. Project objectives

This project aimed to:

- Examine the performance of autistic and control children on ASD measurement tools.
- Determine if age and/or gender has a significant effect upon the scores obtained from the ASD measurement tools in the autistic and control groups separately.

- Examine the classifier performance, including the sensitivity and specificity, of the ASD measurement tools for the diagnosis of ASD in the autistic children.
- Establish thresholds adapted to Qatari population for several cognitive and neuropsychological measures for the diagnosis of children with ASD.

9. Methodology

9.1. Participants:

The study population comprised of 181 children (108 boys and 73 girls), aged 9-11 years old, split into two groups; autistic and control. The autistic group of subjects (n=52) were recruited from three canter: Al-Shafallah Center. The autistic group mainly consisted of children diagnosed and treated with ASD, but also included a sample of children who were diagnosed and treated for disorders with similar symptoms: Mental Retardation, Language Disorder, OCD or ADHD. This heterogeneity enabled the predictive ability of the ASD measurement tools to be assessed. The control group (n=129) was carefully selected in order to accurately compare the results against the autistic group.

9.2. Measures:

Firstly, we identified all available ASD tools used frequently by practitioners at the Al-Shafallah Center (Appendix 1). From these we selected a battery of five tests to be administered to all participants; these five tests encompassed a variety cognitive functions enabling a thorough assessment of the participants cognition. The five standardized instruments selected are as follows:

9.2.1. **Vocabulary and Block Design subtests from the Wechsler Intelligence Scale for Children - Forth Edition (WISC4), and the Weschler Preschool and Primary Scale of Intelligence – Fourth Edition (WPPSI-4):** Since Autism can occur at any point on the intelligence continuum, we required an index of verbal (Vocabulary) and nonverbal (Block

Design) intellectual functioning and not an IQ. These subtests also offer valuable data about language and visuo-spatio-motor skills.

9.2.2. **Pons and Harris Test for Emotion Comprehension (TEC):** This test assesses the development of emotional understanding in children. The TEC consists of a picture book showing a sequence of cartoons presented in a fixed order of increasing difficulty, and has two versions, one for males and one for females. The TEC assesses nine components of emotion comprehension in children aged 3 to 11 years of age: recognition of emotion on the basis of facial expressions, understanding emotion using situational contexts, comprehension of external causes of emotion, understanding of desire-based emotions, the comprehension of belief-based emotion, understanding of the influence of a reminder on present emotional state, the regulation and control of emotions, comprehension of hiding or dissimulating an underlying emotion, understanding of mixed emotion, and understanding of moral emotions.

9.2.3. **Stroop-Like Interference task:** This test is used to assess inhibitory processes and executive function, and involves the demonstration of interference in the reaction time of recalling the correct word. This has been widely used as a cognitive assessment and as a measure of competence in selective attention. For this study we selected two age-appropriate versions of the Stroop-like tasks: the Real Animal Size Test (Catale and Meulemans, 2009) and the Pictorial Animal Size Test (Ikeda, Okuzumi, and Kokubun, 2012). In these tests, participants are presented with pictures of animals (large animals such as an elephant, and small animals such as a frog) printed as either big or small images that are mismatched with the animal's real size. The Real Animal Size Test requires participants to report the real size of animals; and the Pictorial Animal Size Test

requires participants to report the pictorial size of the animals.

10. Statistical Analysis:

Statistical analyses were conducted using SPSS (version 26) and MedCalc (version 19.1.3) and are split into three sections: descriptive assessment of test performance across all children, analysis of gender and age effects on each test in both the control and autistic groups independently, and finally the classification ability of each test for the diagnosis of ASD within the autistic group was determined. Analysis of variance (ANOVA) tests were utilised to identify age and gender effects, followed by Bonferroni post-hoc comparisons when appropriate, while Receiver Operating Characteristics (ROC) and Area Under the Curve (AUC) analysis was used to determine predictive ability.

11. Results

11.1. Descriptive assessment of test performance across all participants.

Descriptive statistics (mean, median, Min. and maximum values) were calculated for each measure across all participants (control and autistic groups combined). Participants were divided into three groups according to their age (9, 10 and 11+ years old) and descriptive statistics were also calculated separately for each age group and also for each gender. These results are all displayed in Table 3 below. The mean score of every test increased with age, and girls scored consistently higher on average across all measures.

Table 3. Descriptive statistics for each measure; across all participants and individually for each age group and gender.

Group		BD	V	TEC	SCCT1	SCCT2	SCCT3	SCCE1	SCCE2	SCCE3
All participants	Mean	11.08	30.21	12.71	18.24	28.66	31.14	1.35	2.49	3.39
	N	181	181	181	181	181	181	181	180	180
	Median	11	39	15	23	37	41	1	3	4
	Min.	0	0	0	0	0	0	0	0	0
	Max.	22	51	24	36	48	50	44	5	8
9-Years Group	Mean	5.93	19.56	8.3	12.7	21.11	22.52	0.95	1.89	2.67
	N	27	27	27	27	27	27	27	27	27
	Median	7	32	9	14	34	38	0.32	2	3
	Min.	0	0	0	0	0	0	0	0	0
	Maximum	18	43	22	33	46	50	3	5	8
10-Years Group	Mean	9	30.29	11.94	19.04	29.46	31.4	1.08	2.54	3.6
	N	72	72	72	72	72	72	72	72	72
	Median	10	38	14	23	37	40	1	3	4.5
	Min.	0	0	0	0	0	0	0	0	0
	Maximum	22	48	23	36	46	49	3	5	6
11-years and above	Mean	14.61	33.65	14.84	19.37	30.44	33.76	1.72	2.65	3.46
	N	82	82	82	82	82	82	82	81	81
	Median	17.5	42	17	24	38	45	1	3	4
	Min.	0	0	0	0	0	0	0	0	0
	Maximum	22	51	24	34	48	50	44	5	6
Boys	Mean	9.53	25.54	11.19	14.33	23.91	25.98	1.31	2.13	2.87
	N	108	108	108	108	108	108	108	107	107

	Median	9.5	36	13	18	34	39	0.86	3	4
	Min.	0	0	0	0	0	0	0	0	0
	Maximum	22	51	24	34	46	50	44	5	8
Girls	Mean	13.38	37.12	14.96	24.03	35.68	38.78	1.4	3.03	4.16
	N	73	73	73	73	73	73	73	73	73
	Median	13	41	16	26	40	43	1	3	5
	Min.	0	0	0	0	0	0	0	0	0
	Maximum	22	51	24	36	48	50	3	5	6

*BD=-Block Design, V=*Vocabularies, TEC= *Test for Emotion Comprehension, SCCT1= Stroop Control condition (Reaction Time1), SCCT2= Stroop Congruent condition (Reaction Time2), SICT3 = Stroop Incongruent condition(Reaction Time3), SCCE1=Stroop Control condition (Errors1) Stroop Congruent condition (Errors2) Stroop Incongruent condition(Errors3).*

Descriptive statistics were also calculated for the autistic and control groups separately (Table 4). Average scores for all measures were consistently lower for the autistic group compared to the control group.

Table 4. Descriptive statistics for each measure for the control and autistic groups.

Group		BD	V	TEC	SCCT1	SCCT2	SCCT3	SCCE1	SCCE2	SCCE3
	Mean	14.05	41.43	17.11	25.47	39.84	43.35	1.87	3.43	4.65
	N	129	129	129	129	129	129	129	129	129
Control	Median	14	41	17	25	40	44	1.41	3	5
	Min.	7	31	8	15	32	4	0	1	3
	Maximum	22	51	24	36	48	50	44	5	6
	Mean	3.71	2.37	1.81	0.31	0.9	0.87	0.06	0.14	0.22
	N	52	52	52	52	52	52	52	51	51
Autistic	Median	0	0	0	0	0	0	0	0	0
	Min.	0	0	0	0	0	0	0	0	0
	Maximum	22	41	22	14	43	40	3	5	8

*BD=-Block Design, V=*Vocabularies, TEC= *Test for Emotion Comprehension, SCCT1= Stroop Control condition (Reaction Time1), SCCT2= Stroop Congruent condition (Reaction Time2), SICT3 = Stroop Incongruent condition(Reaction Time3), SCCE1=Stroop Control condition (Errors1) Stroop Congruent condition (Errors2) Stroop Incongruent condition(Errors3).*

11.2. Analysis of gender and age effects on each test in both the autistic and control groups independently.

11.2.1. Control group results

To determine whether age, gender, or their interaction had an effect upon the scores achieved by the control group in the Block Design, Vocabularies and Emotion Comprehension tests, a two-way between groups ANOVA was conducted. The results identified a statistically significant main effect of age for all three tests (Block Design: $F(2, 123) = 291.65$, $p < 0.005$; Vocabularies: $F(2, 123) = 28.60$, $p < 0.005$; Emotion Comprehension: $F(2, 123) = 24.52$, $p < 0.005$). Post-hoc comparisons using the Bonferroni test indicated that the mean scores significantly differed across all three age groups for both the Block Design and Vocabularies tests ($p < 0.005$). For the Emotion Comprehension test, scores were found to significantly differ between the 9 and 11 year old age groups ($p < 0.005$) and between the 10 and 11 year old age groups ($p < 0.005$), but no significant

difference was reported between scores from the 9 and 10 year old age groups ($p = 0.49$). No significant main effect of gender or interaction effect between age and gender were found ($p > 0.05$). Taken together, these results suggest that scores for all three tests generally improve with age but that gender has no impact upon performance within the control group.

As the Stroop-like test consisted of three conditions (control, congruent and incongruent), a one-way repeated measures ANOVA was conducted to compare reaction time scores across all three conditions. There results identified a significant main effect of Stroop condition upon normal children's reaction time: Wilks' Lambda = .117, $F (2, 127) = 134.98$, $p < .001$, multivariate partial eta squared = .551. Reaction times were quickest in the control condition (Mean = 25.47, S.D = 5.23) and slowest in the incongruent condition (Mean = 43.35, S.D = 5.06).

The Stroop-like test also provides data on the number of errors made during the test. A one-way repeated measures ANOVA was conducted to compare errors made across all three test conditions. The results identified a significant main effect of Stroop condition upon normal children's errors: Wilks' Lambda = 0.40, $F (1, 128) = 834.23$, $p < 0.005$, Partial Eta Squared= .251. The lowest number of errors were reported in the control condition (Mean = 1.87, S.D. = 3.84) and the highest number was found in the incongruent condition (Mean = 4.65, S.D. = 0.98).

To explore the impact of age and gender upon reaction times for each of the three Stroop-like test conditions a two-way between-groups analysis of variance was conducted. The interaction effect between gender and age group was not statistically significant ($p = 0.65$). There was however a statistically significant main effect of both age and gender; Age: $F (1, 23) = 0.15$, $p = 0.03$; Gender: $F (1, 123) = 19.68$, $p = 0.001$. Post-hoc comparisons using the Bonferroni test indicated that the mean scores significantly differed ($p < 0.05$) between the 10 years group (M = 35.56, SD =4.35) and the 11 years and above age group (M = 36.70, SD = 0.35). No significant difference was reported between the 9 years age group (M = 37.47, SD = 4.89) and either the 10 or 11 years and above age groups ($p > 0.05$). The means and standard deviations for reaction times across all conditions, split by age group and gender, are displayed in Appendix 2.

To explore the impact of age and gender upon errors made in each of the three Stroop-like

test conditions a two-way between-groups analysis of variance was conducted. The results indicated that the interaction effect between gender and age group was not statistically significant, F (2, 123) = 1.18, p = 0.31. There was not a statistically significant main effect for age, F (1, 123) = 1.195, p = 0.15;). There was also not a statistically significant main effect for gender, F (1, 123) = .002, p =. 961).

11.2.2. 2.2. **Autistic group results**

To determine whether age, gender, or their interaction had an effect upon the scores achieved by the control group in the Block Design, Vocabularies and Emotion Comprehension tests, a two-way between groups ANOVA was conducted. No significant main effect of age, gender or an age x gender interaction was found ($p > 0.05$). These results indicate that age and gender have no impact upon performance for the autistic group participants. The mean scores and standard deviations for these three tests, split by both age and gender, are reported in Appendix 4.

A one-way repeated measures ANOVA was conducted to compare reaction time scores for the autistic participants across all three Stroop-like test conditions. No significant main effect of Stroop condition upon autistic children's reaction time was identified ($p = 0.31$). The same analysis was conducted to compare errors made across all three test conditions. No significant main effect of Stroop condition upon autistic children's errors were identified ($p < 0.18$).

To explore the impact of age and gender upon reaction times for each of the three Stroop-like test conditions a two-way between-groups analysis of variance was conducted. No significant main effect of age, gender or an age x gender interaction was identified ($p > 0.05$). The same analysis was conducted to examine the impact of age and gender upon errors made in each of the three Stroop-like test conditions. No significant main effect of age, gender or an age x gender interaction was identified ($p > 0.05$). The means and standard deviations across all conditions, split by age group and gender, are displayed for reactions times in Appendix 5 and errors made in Appendix 6.

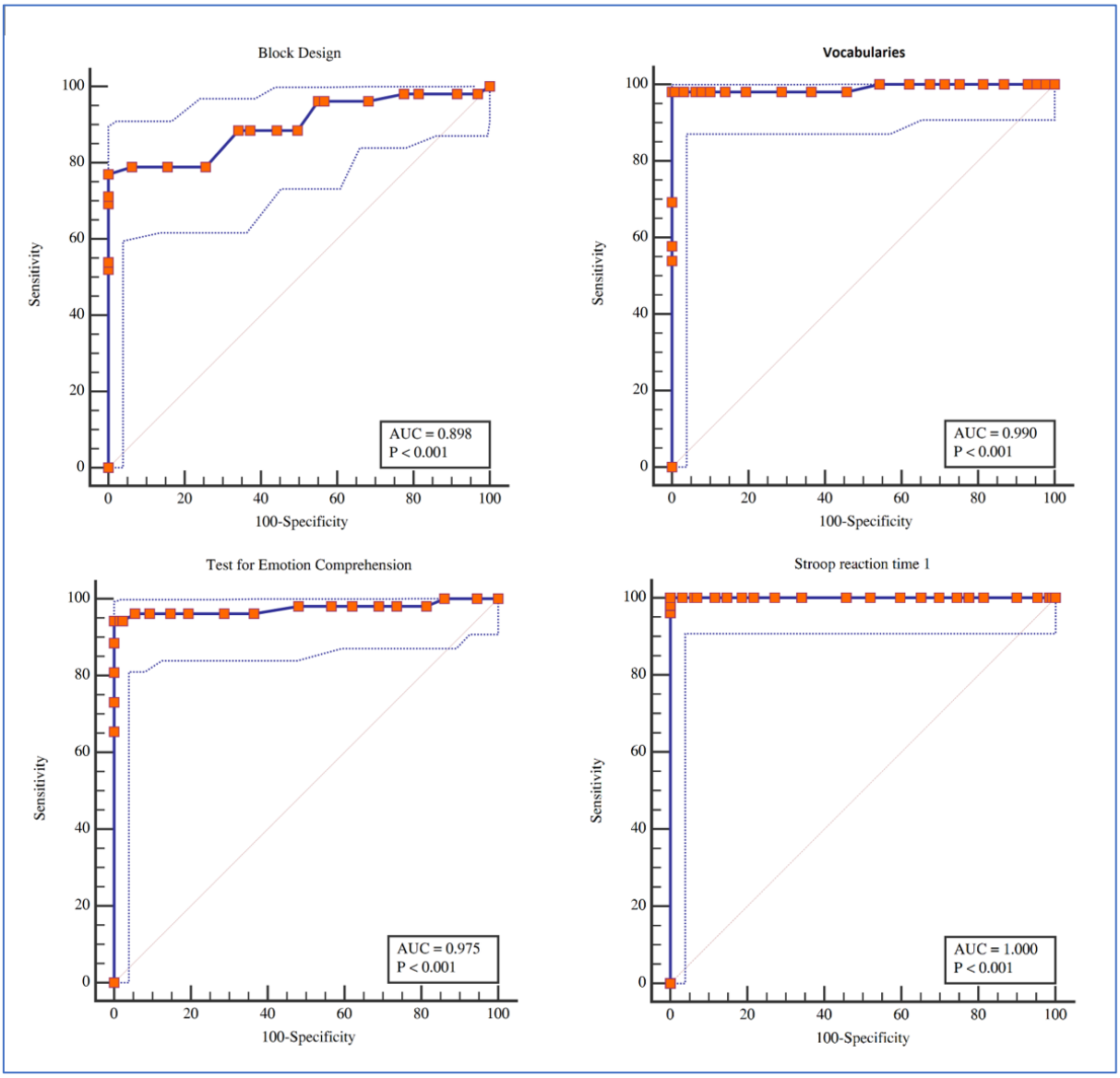
11.3. Classification ability of each test for the diagnosis of ASD within the autistic group

ROC and AUC statistics were calculated for each ASD measurement tool in order to determine their classification ability for ASD diagnosis. Table 5 displays the results including the

optimal cut-off values, sensitivity, specificity and confidence intervals, and Figure 1 displays the ROC curve and classifier performance of each ASD measurement tool for the diagnosis of ASD. All 10 measures had extremely high classification abilities for ASD diagnosis for the autistic participants in this study, with the Stroop-like test condition 1 (reaction time 1) performing the best with perfect accuracy (AUC = 1, sensitivity = 100%, specificity = 100%, $p < 0.0005$ and a positive predictive value (PPV) = 100%).

Table 5. Classification performance of each ASD measurement tool for the diagnosis of ASD in the autistic group.

Parameters	Cutoff \value	95% Confidence interval a	Sensitivity (%)	Specificity (%)	AUC (95% Confidence Interval)	p
Block Design	≤6	≤5 to ≤7	76.92	100	.896 (.833-.958)	.000
Vocabularies	≤4	≤4 to ≤4	98.08	100	.990 (.971--1.009)	.000
Test for Emotion Comprehension	≤6	≤4 to ≤10	94.23	100	.975 (.939-1.010)	.000
Stroop reaction time 1	≤4	≤2 to ≤14	100	100	1.000 (1.000-1.000)	.000
Stroop reaction time 2	≤4	≤0 to ≤4	98.08	100	.986 (.960-1.013)	.000
Stroop reaction time 3	≤5	≤0 to ≤5	98.08	99.22	.996 (.987-1.004)	.000
Stroop error 1	≤0	≤0 to ≤0.32	96.15	93.02	.946 (.903-.990)	.000
Stroop error 2	≤0	≤0 to ≤0	96.08	100	.980 (.944-1.016)	.000
Stroop error 3	≤0	≤0 to ≤0	96.08	100	.979 (.941-1.017)	.000


Block Design
Sensitivity
100-Specificity
AUC = 0.898
P < 0.001
Vocabularies
Sensitivity
100-Specificity
AUC = 0.990
P < 0.001
Test for Emotion Comprehension
Sensitivity
100-Specificity
AUC = 0.975
P < 0.001
Stroop reaction time 1
Sensitivity
100-Specificity
AUC = 1.000
P < 0.001

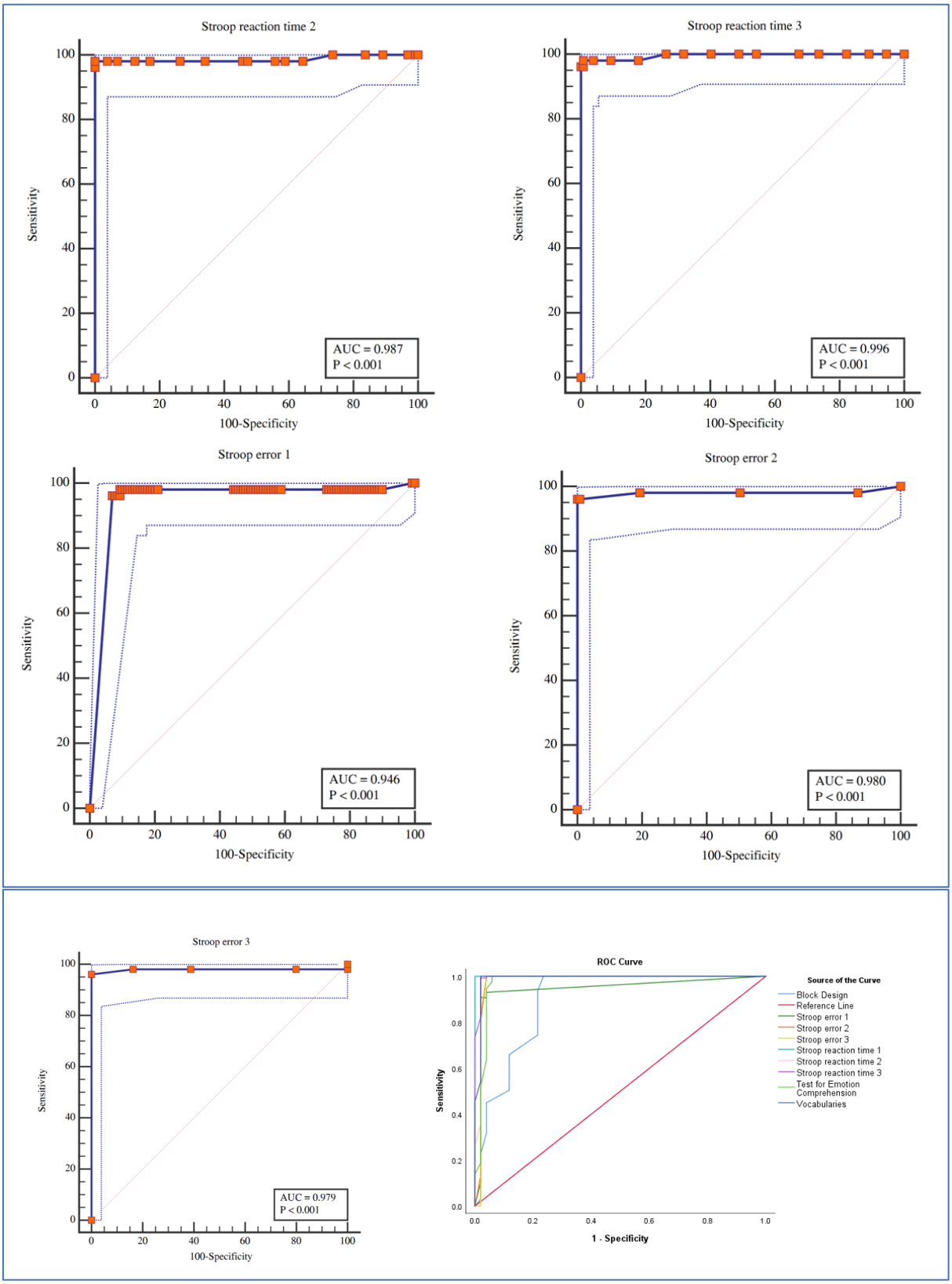


Figure 1. ROC curves and classification performance of each ASD measurement tool for the diagnosis of ASD in the autistic group.

12. Discussion

The main aim of this project was to examine the performance of ASD measurement tools in autistic and control children and determine the validity of these tools for ASD diagnosis in Arab children. In order to do this, 181 autistic and control children were selected and a battery of five ASD assessment tools was administered. These five tools were selected from those currently in use at the Al-Shafallah Center as we believed together this battery of measures encompassed a range of cognitive functions and would therefore provide a thorough assessment of cognition.

Average scores obtained for all measures were consistently lower for the autistic group compared to the control group. This reveals that control children performed better on average across all tests, except for the Stroop-like test in which a lower score represents a faster reaction time. It is important to note that this finding should be considered with caution, due to a data normality violation in the autistic sample. Nevertheless, children with ASD often outperform typically developing children on Stroop-like tests; this is thought to be due to a lack of inhibition and increased impulsivity, and our results corroborate these previous findings. Overall the difference in mean scores between the autistic and control groups provided an initial indication that the ASD measurement tools were sensitive to the autistic / control status of the children.

When assessing the sample population as a whole, the mean score of every test increased with age, and girls scored consistently higher on average across all measures. This highlights the importance of investigating the effect of age and gender upon the diagnostic ability of these measurements. If age and/or gender was found to influence scores from the autistic children, the resulting diagnostic thresholds may need to be adjusted for age and gender, or age and gender specific thresholds may need to be provided. However, when we looked at the effects of age and gender in the autistic children only, no main effects of age or gender were identified. ASD characteristics are known to change over time and therefore it would be expected for age to have an influence upon the ASD measurement results. This was not the case for our study. However, a 9-11-year-old age range may not be wide enough to see an impact of changing symptoms; perhaps ASD characteristics change too slowly or do not change at all within this time window. It would also be interesting to investigate this result further, again within an Arab context, in order to identify if

this is a culturally specific finding. Nevertheless, the results from this study indicate that any calculated thresholds for an ASD diagnosis can be considered stable between the ages of 9-11, and across genders, in our group of autistic Arab children. When we looked at the results from the control children only, main effects of age and gender were identified frequently and therefore we can conclude that the age and gender differences observed across the whole cohort are driven by the control children only.

When examining the classification ability of the ASD measurement tools, data from the autistic group only was utilised. This autistic group consisted of children with an ASD diagnosis, but also children with disorders that have similar symptoms to ASD. Therefore, testing the diagnostic ability of these ASD measures in this heterogeneous group of children examined their ability to differentiate between disorders commonly misdiagnosed for one another. Our results show that all measures had extremely high classification ability for ASD diagnosis for the autistic participants in this study, with the Stroop-like test condition 1 (reaction time 1) performing the best with perfect accuracy (100%).

As previously discussed, age and gender were not found to impact upon the scores of any of the ASD measurements. Therefore, we can assume that the excellent classification performance of these measures will remain stable over time for Arab children aged 9-11 years old. Optimal cut-off values were calculated during the ROC analysis; these indicate the thresholds after/before which an accurate ASD diagnosis can be made. Further testing in a larger sample size is suggested to refine and replicate these cut-off points, however our thresholds can be used as a reference to compare the results of future studies to.

The prevalence of autism in Arabic cultures is lower than expected, thought to be due to the difficulties in diagnosing children with ASD and a high occurrence of misdiagnosis. The results of this study show that the ASD measurement tools in place at the Al-Shafallah Center are sufficient to guide the diagnosis of ASD in Arab children. Updating the score thresholds used by these measures to indicate ASD should be considered to improve diagnostic rates and reduce misdiagnosis. The results of this study can be used as a reference point for this, but further replication is required. Efforts to increase public awareness and the knowledge and education of

healthcare professionals would also be beneficial to the efficient detection and accurate diagnosis of ASD in Arab children.

13. Conclusions/recommendations

A diagnosis of ASD should always be made following an in-depth clinical evaluation assessing many areas of cognition, behaviour, relationships and general activities of daily living. Input from parents and caregivers can also provide a valuable insight into the child's normal behaviour. Nevertheless, the outstanding performance of the ASD measurement tools assessed in this study indicate that a strong recommendation should be made for including these measures in any clinical work-up of an Arab child with possible ASD. Replication of the results of this study should now be sought in a larger sample population. Our overall conclusions and recommendations from this study are:

- The battery of ASD measurement tools examined in this study has excellent classification ability for ASD in Arab children.
- The Stroop-like test performed particularly well with 100% accuracy and if replicated should be recommended for all ASD assessments in Arab children.
- Age and gender do not affect the classification ability of these measures in autistic Arab children aged between 9-11 years old.

14. Key messages

The key messages resulting from this study are as follows:

- The ASD measurement tools used at the Al-Shafallah Center are valid for use with Arab children.
- These ASD measurement tools have excellent accuracy in differentiating between ASD and disorders with similar symptoms in Arab children.
- Scores obtained from the ASD assessment tools do not need to be adjusted for age and/or gender in autistic Arab children.

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15. Appendices

Appendix 1. List of ASD Measures available at Al-Shafallah Center

1.ستانفورد – بينيه للذكاء – الصورة الخامسة	2. مقياس DOCS
3.مقياس وكسلر غير اللفظي WNV	4.مقياس DAP:IQ
5.دليل مقياس كارز -2 CARS-2	6.مقياس PKBS-2
7.جداول الملاحظة التشخيصية للتوحد ADOS-2	8.مقياس ABC
9.مقياس لايتر العالمي المعدل للذكاء LEITER R	10.مقياس TONI-3
11.مقياس وكسلر للتحصيل WIAT	12. مقياس رافن
13.مقياس وود كوك جونسون للذكاء والتحصيل	14.مقياس WASSI
15.كتاب الدليل العاشر للامراض النفسية ICD-10	16.مقياس TAAP
17.كتاب الدليل العاشر للامراض النفسية ICD-10	18.مقياس BERRY-VMI
19.مقياس ميريل بالمر للذكاء	20.مقياس BERRY-VMI
21.المقياس النفسي – تعليمي PEP-3	22.مقياس ASEBA
23.مقياس بريجانس Brigance	Function communication Profile.24
25.مقياس Bilingual - BVAT	26.مقياس كونرز المعدل CONNERS-R
27.مقياس NEPSY-II	Pre Referral Intervention Manual.28
29.مقياس WRAML	RCFT.30
31.مقياس WPSSI-III	SIBS.32
33.مقياس وكسلر الرابعة – النسخة الأمريكية WISC-IV	A Compendium of Neuropsychological Tests.34
35.مجموعة اختبارات صعوبات التعلم	Preschool language Scale PLS-5.36
37.مقياس CARS-1	38.قائمة فحص الوظائف الحركية الكبرى
39.مقياس السلوك ABAS	40.قائمة فحص بيرج للتوازن
41.مقياس SIT-R3	42.أداة تقييم العلاج الوظيفي المسحية
43.مقياس FIM	

Appendix 2. List of means and standard deviations for the reaction times of control participants at each Stroop-like test condition, split by age group and gender.

Condition	Age Group	Gender	Mean	SD	N
Control condition (Reaction Time1)	9-Years Group	Boys	23.90	6.590	10
		Girls	29.33	4.726	3

	10-Years Group	Boys	23.68	5.041	28
		Girls	27.23	4.844	26
	11-years and above	Boys	23.33	5.015	27
		Girls	27.37	4.366	35
Congruent condition (Reaction Time2)	9-Years Group	Boys	39.40	3.406	10
		Girls	43.00	5.196	3
	10-Years Group	Boys	37.93	4.776	28
		Girls	40.73	3.365	26
	11-years and above	Boys	39.96	4.238	27
		Girls	40.49	4.402	35
Incongruent condition (Reaction Time3)	9-Years Group	Boys	42.20	3.120	10
		Girls	47.00	3.00	3
	10-Years Group	Boys	41.61	3.270	28
		Girls	42.15	3.295	26
	11-years and above	Boys	43.48	8.671	27
		Girls	45.54	3.052	35

Appendix 3. List of means and standard deviations for the errors made by control participants at each Stroop-like test condition, split by age group and gender.

Condition	Age Group	Gender	Mean	SD	N
Control condition (Error 1)	9-Years Group	Boys	1.84	.864	10
		Girls	1.28	.492	3
	10-Years Group	Boys	1.32	.782	28
		Girls	1.57	.880	26
	11-years and above	Boys	3.08	8.227	27
		Girls	1.64	1.011	35
Congruent condition (Error2)	9-Years Group	Boys	3.30	.823	10
		Girls	3.67	1.528	3
	10-Years Group	Boys	3.50	1.036	28
		Girls	3.27	1.002	26
	11-years and above	Boys	3.33	1.00	27
		Girls	3.57	.884	35
Incongruent condition	9-Years Group	Boys	4.90	.994	10
		Girls	4.00	1.00	3

(Error3)					
	10-Years Group	Boys	4.79	.957	28
		Girls	4.81	1.021	26
	11-years and above	Boys	4.19	.962	27
		Girls	4.77	.910	35

Appendix 4. List of mean scores and standard deviations for the autistic group, split by both age and gender, for the Block Design, Vocabularies and Emotion Comprehension tests.

Measure	Gender	Age Group	Mean	SD	N
Block Design	Boys	9-Years Group	4.54	5.636	13
		10-Years Group	5.33	6.986	15
		11-years and above	1.73	3.770	15
	Girls	9-Years Group	.00	0	1
		10-Years Group	1.33	1.155	3
		11-years and above	4.80	6.723	5
Vocabularies	Boys	9-Years Group	5.08	10.943	13
		10-Years Group	1.80	2.007	15
		11-years and above	1.13	1.727	15
	Girls	9-Years Group	.00	0	1
		10-Years Group	2.00	2.00	3
		11-years and above	1.40	1.949	5
Test for Emotion Comprehension	Boys	9-Years Group	3.38	6.292	13
		10-Years Group	.93	1.792	15
		11-years and above	.80	1.821	15
	Girls	9-Years Group	.00	0	1
		10-Years Group	5.67	8.963	3
		11-years and above	1.40	2.608	5

Appendix 5. List of means and standard deviations for the reaction times of autistic participants at each Stroop-like test condition, split by age group and gender.

	Age Group	Gender	Mean	SD	N
Control condition (Time1)	9-Years Group	Boys	1.23	3.876	13
		Girls	.00	0	1
	10-Years Group	Boys	.00	.00	15
		Girls	.00	.00	3
	11-years and above	Boys	.00	.00	15
		Girls	.00	.00	5
Congruent condition (Time2)	9-Years Group	Boys	3.62	11.885	13
		Girls	.00	.	1
	10-Years Group	Boys	.00	.00	15
		Girls	.00	.00	3
	11-years and above	Boys	.00	.00	15
		Girls	.00	.00	5
Incongruent condition (Time3)	9-Years Group	Boys	3.46	11.065	13
		Girls	.00	.	1
	10-Years Group	Boys	.00	.00	15
		Girls	.00	.00	3
	11-years and above	Boys	.00	.00	15
		Girls	.00	.00	5

a. Groups = Autistic

Appendix 6. List of means and standard deviations for the errors made by autistic participants at each Stroop-like test condition, split by age group and gender.

	Age Group	Gender	Mean	SD	N
Control condition (Error 1)	9-Years Group	Boys	.26	.829	13
		Girls	.00	0.	1
	10-Years Group	Boys	.00	.00	15
		Girls	.00	.00	3
	11-years and above	Boys	.00	.00	14
		Girls	.00	.00	5
Congruent condition (Error2)	9-Years Group	Boys	.54	1.450	13
		Girls	.00	0	1

	10-Years Group	Boys	.00	.00	15
		Girls	.00	.00	3
	11-years and above	Boys	.00	.00	14
		Girls	.00	.00	5
Incongruent condition(Error3)	9-Years Group	Boys	.85	2.304	13
		Girls	.00	0	1
	10-Years Group	Boys	.00	.00	15
		Girls	.00	.00	3
	11-years and above	Boys	.00	.00	14
		Girls	.00	.00	5

a. Groups = Autistic

Appendix 7. Measures used in this project

Appendix 7.1.


TEC- النسخة العربية.pdf


TEC تصحيح.pdf


TEC-Boys.pdf


TEC-Girls.pdf


Stroop Animals-same size.p


Stroop Animals-conflictual.p


Stroop Animals-real size.pdf


Q-WISC 4-Vocal-1.pdf


Q-WISC 4-vocab 2.pdf


Q-WISC 4-cubes.pdf


Cubes.pdf

أخبرني بالحجم الحقيقي للحيوان الذي تراه، بغض النظر عن حجمه في الصورة | Stroop Animals- real size

ص	ص	ك	ص	ص	ك	ك	ص
ك	ك	ص	ك	ص	ص	ص	ك
ك	ك	ص	ص	ك	ك	ك	ص
ص	ك	ك	ك	ك	ص	ص	ك
ك	ص	ك	ص	ص	ك	ك	ك
ك	ص	ص	ص	ك	ص	ص	ص
ص	ك	ص	ك	ك	ك	ك	ص
ك	ص	ك	ص	ص	ص	ص	ك
ص	ك	ص	ك	ص	ك	ك	ك

أخبرني بالحجم الحقيقي للحيوان الذي تراه، بغض النظر عن حجمه في الصورة | Stroop Animals-same size

ص	ص	ك	ص	ص	ك	ك	ص
ك	ك	ص	ك	ص	ص	ص	ك
ك	ك	ص	ص	ك	ك	ك	ص
ص	ك	ك	ك	ك	ص	ص	ك
ك	ص	ك	ص	ص	ك	ك	ك
ك	ص	ص	ص	ك	ص	ص	ص
ص	ك	ص	ك	ك	ك	ك	ص
ك	ص	ك	ص	ص	ص	ص	ك
ص	ك	ص	ك	ص	ك	ك	ك

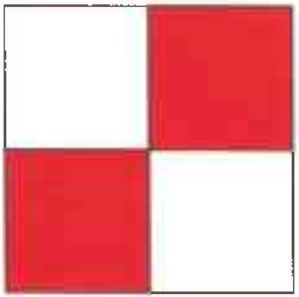
أخبرني بحجم الحيوان الذي تراه، كما هو حجمه في الصورة | Stroop Animals-conflictual

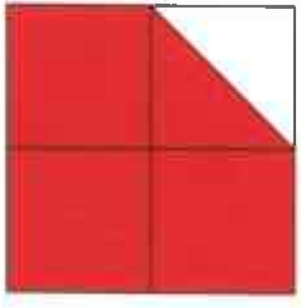
ك	ص	ص	ك	ك	ص	ك	ك
ك	ص	ص	ص	ص	ك	ك	ص
ص	ص	ك	ص	ك	ص	ك	ك
ك	ص	ك	ص	ص	ص	ك	ص
ص	ك	ص	ص	ك	ص	ك	ص
ك	ك	ك	ك	ص	ك	ك	ك
ك	ص	ك	ص	ص	ص	ك	ك
ص	ك	ص	ك	ك	ص	ك	ك
ص	ص	ك	ص	ك	ك	ص	ص

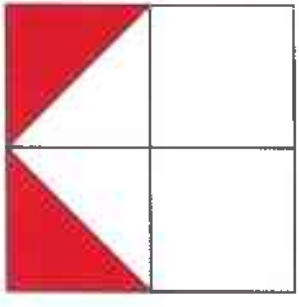
TEC

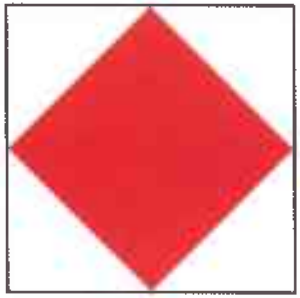
1	حزين	
2	فرحان	
3	متعصب	
4	عادي	
5	خائف	
6	حزين	
7	فرحان	
8	غاضب	
9	عادي	
10	خائف	
11	فرحان	
	حزين	
12	حزين	
	فرحان	
13	فرحان	
16	فرحان	
17	حزين	
18	يفكر في شيء آخر	
19	غاضب	
20	خائف	
21	فرحان	
22	فرحان	
23	حزين	

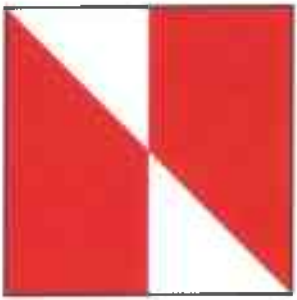
المكعبات

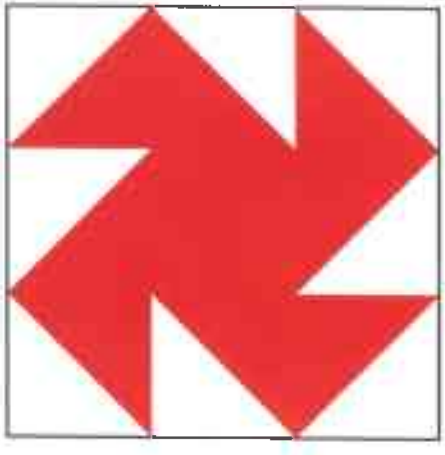


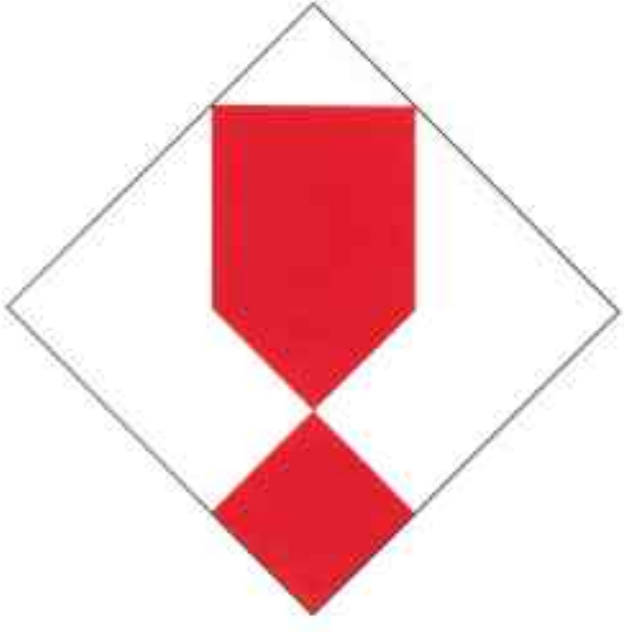


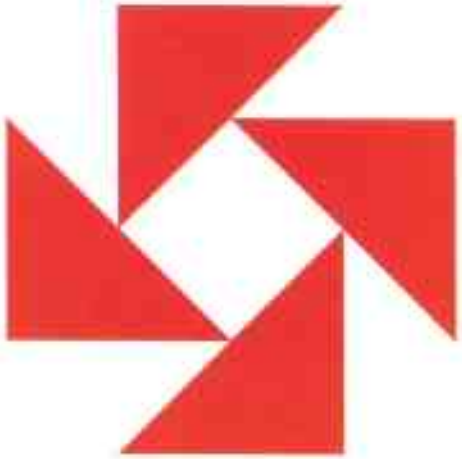












1- المكعبات (لتحديد الوقت تراجع كل فقرة) Block Design

البدء:
7-6 سنوات، البدء من الفقرة رقم 1.
16-7 سنة، البدء من الفقرة رقم 3.

العودة:
العمر (8-16 سنة): إذا كانت الدرجة 0 أو نقطة 1 على احدى الفقرتين الأولتين اللتين بدأ المفحوص بهما يجب اعطاؤه الفقرات السابقة بالترتيب العكسي حتى الحصول على درجتين متتاليتين.

التوقف:
التوقف بعد ثلاثة درجات صفر متتالية.

الدرجات:
من الفقرة 1 الى 3 (0، 1، 2)
من الفقرة 4 الى 8 (0، 1، 2)
من الفقرة 9 الى 14 (0 أو مكافأة حسب التوقيت BDN الفقرة 1 الى 3 (0، 1، 2)
من الفقرة 4 الى 14 (0، 1، 2)

الشكل الصحيح	الشكل	الوقت الأقصى	وقت التطبيق	ن/ر (نجاح / (رسوب)		تطبيق خاطئ	الدرجة						
1	نموذج	30 s		ر	ن	محاولة 1 محاولة 2	0	1	2				
2	نموذج	45 s		ر	ن	محاولة 1 محاولة 2	0	1	2				
3	نموذج وصورة	45 s		ر	ن	محاولة 1 محاولة 2	0	1	2				
4	صورة	45 s		ر	ن		0			4			
5	صورة	45s		ر	ن		0			4			
6	صورة	75s		ر	ن		0			4			
7	صورة	75s		ر	ن		0			4			
8	صورة	75s		ر	ن		0			4			
9	صورة	75s		ر	ن		0			4	30-21	20-11	10-1
10	صورة	75s		ر	ن		0			4	30-21	20-11	10-1
11	صورة	120s		ر	ن		0			4	70-51	50-31	30-1
12	صورة	120s		ر	ن		0			4	70-51	50-31	30-1
13	صورة	120s		ر	ن		0			4	70-51	50-31	30-1
14	صورة	120s		ر	ن		0			4	70-51	50-31	30-1

الدرجة الخام الاجمالية
الدرجة القصوى 68

الدرجة الخام الاجمالية مكعبات بدون مكافأة
الدرجة القصوى 50

6- المفردات (تابع)

الفقرة	الإجابة	الدرجة		
22. دقة		0	1	
23. تعديل		0	1	
24. شبه جزيرة		0	1	
25. خرافة		0	1	
26. اتحاد		0	1	2
27. وشيك		0	1	2
28. مجهد		0	1	2
29. تعبيرات		0	1	2
30. ارغام		0	1	2
31. جدوى		0	1	2
32. متباطئ		0	1	2
33. محنة		0	1	2
34. مهذار		0	1	2
35. حياد		0	1	2
36. تبصر		0	1	2

الدرجة الخام الاجمالية

الدرجة القصوى 68

ملاحظة:

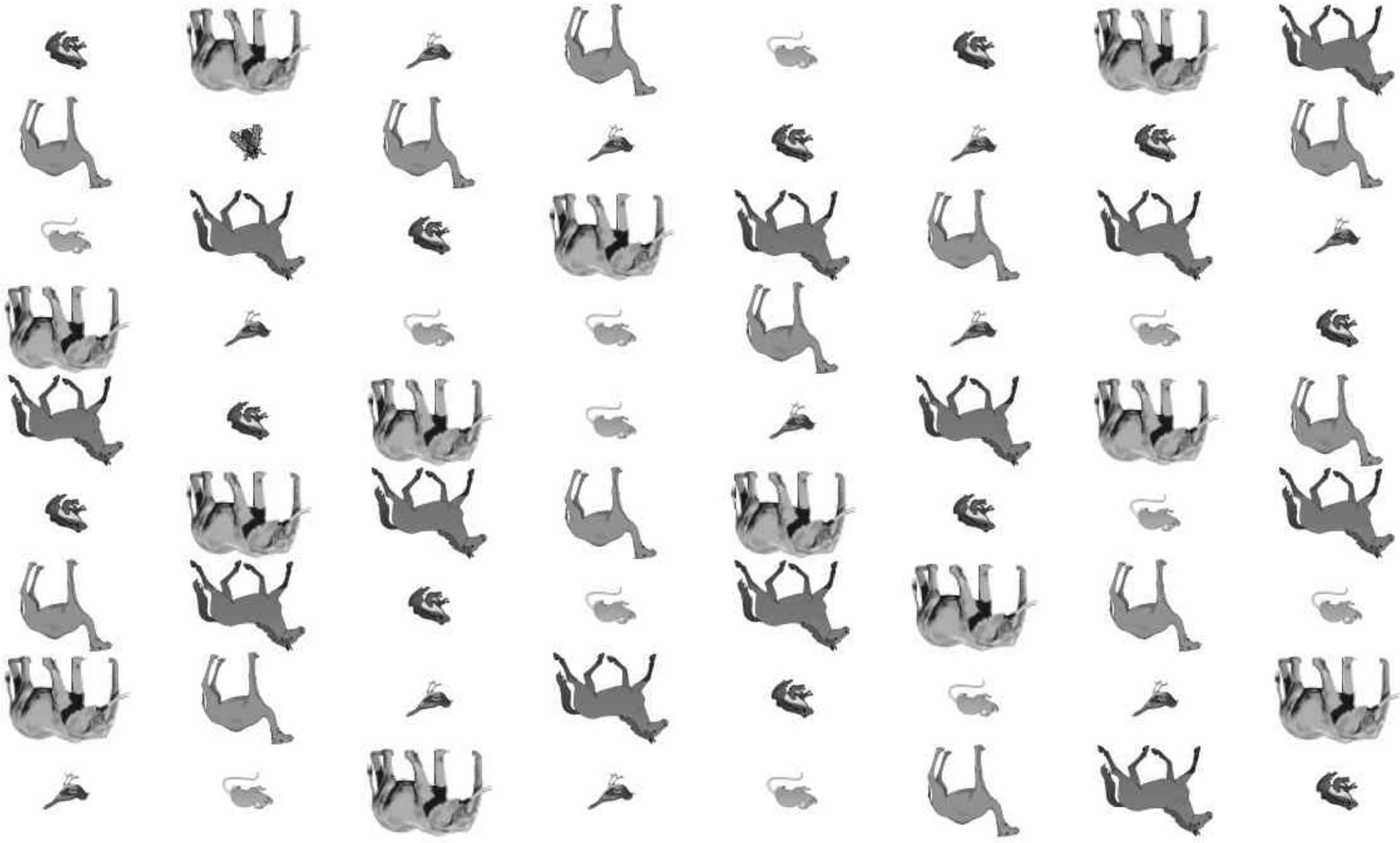
* **إذا لم يعط المفحوص إجابة تحظى بنقطتين، يعطيه الفاحص الإجابة الواردة في "دليل التطبيق والدرجات"**
* **الإجابات التي تتطلب سؤالا محددا، مذكورة في دليل التطبيق والدرجات.**

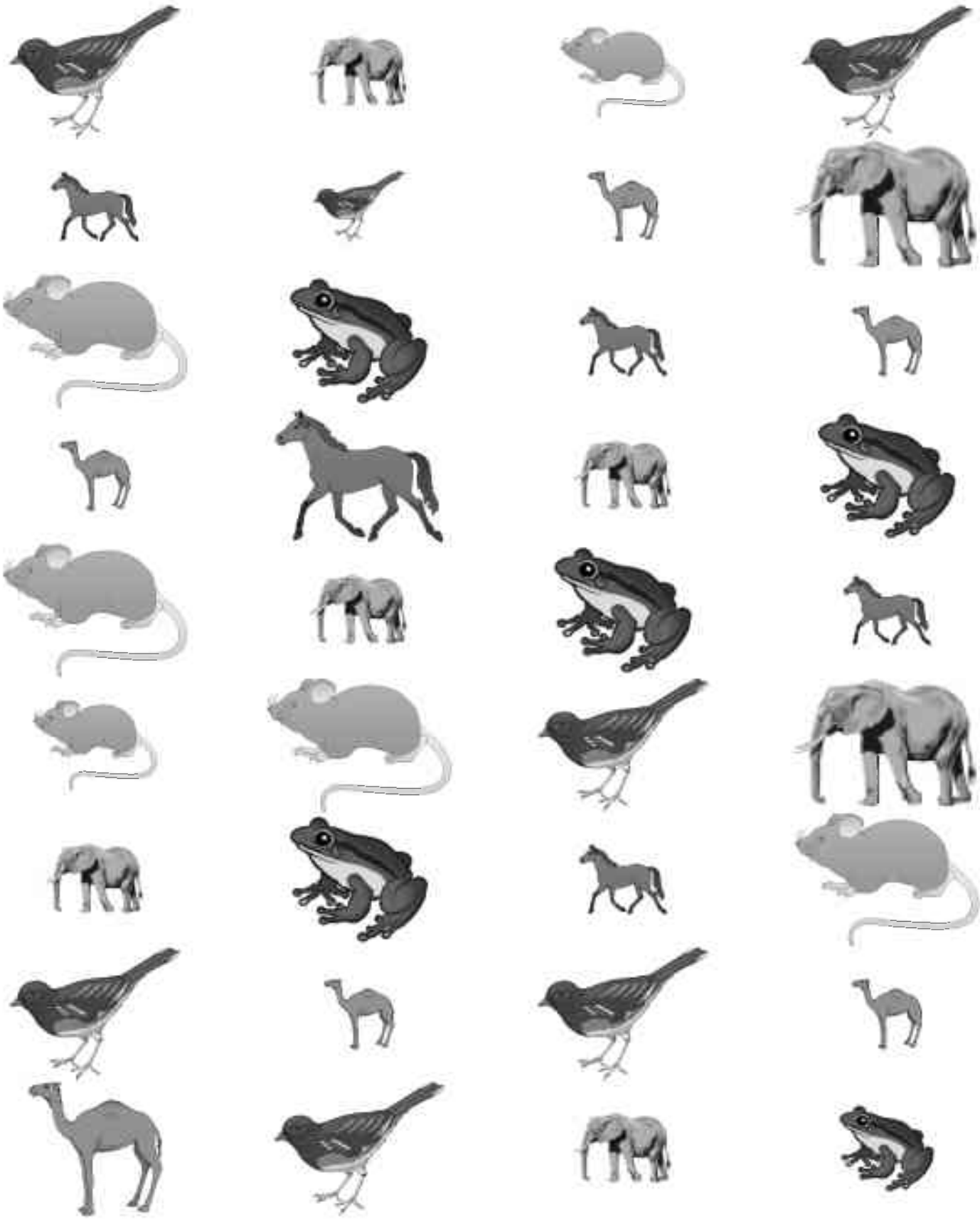
6- المفردات Vocabulary

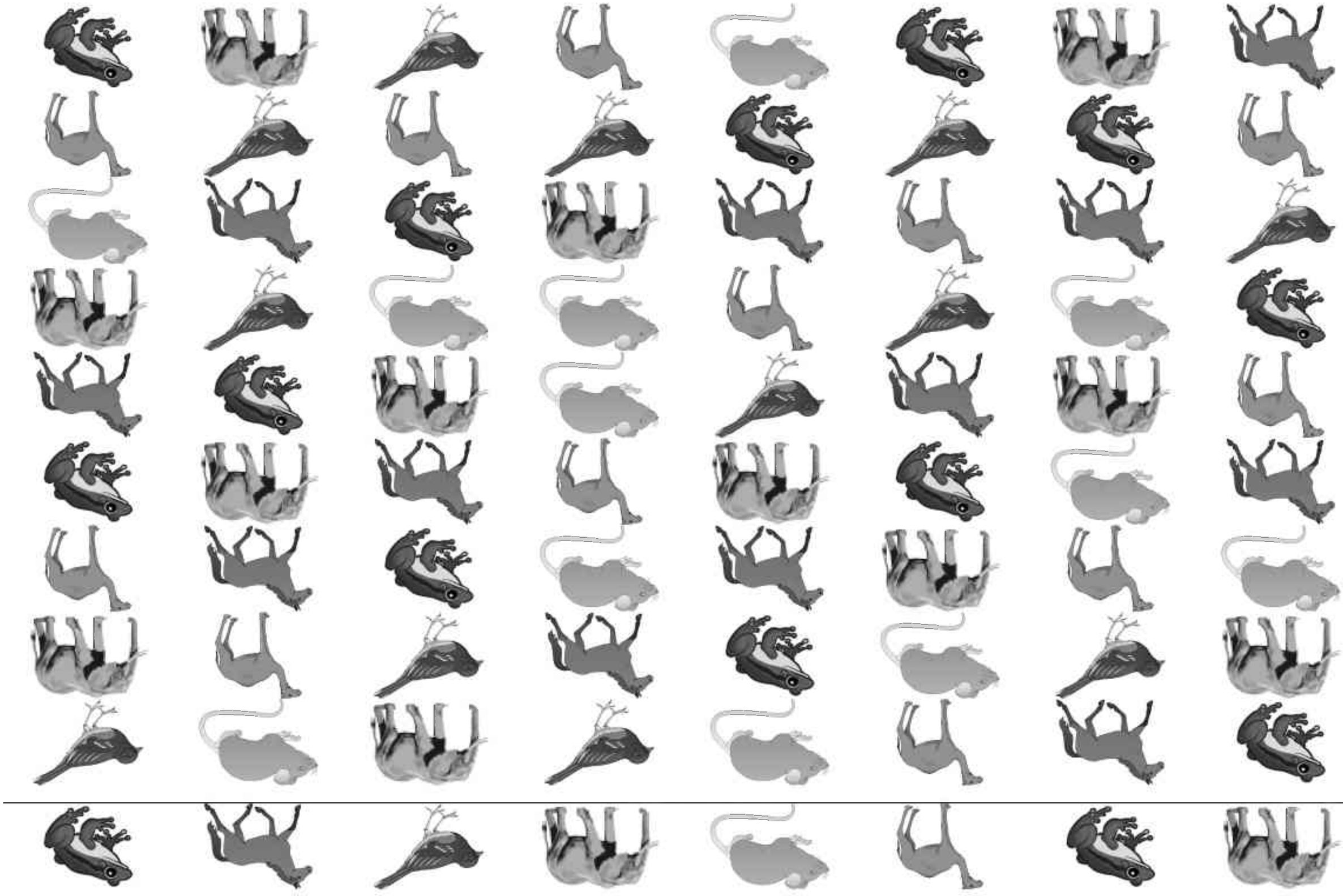
البدء:	العودة:	التوقف:	الدرجات:
6-8 سنوات، البدء من الرقم 5. 9-11 سنة، البدء من الرقم 7. 12-16 سنة، البدء من الرقم 9.	العمر (6-16 سنة): إذا كانت الدرجة 0 أو نقطة 1 على احدى الفقرتين الأولتين اللتين بدأ المفحوص بهما يجب اعطاؤه الفقرات السابقة بالترتيب العكسي حتى الحصول على درجتين 2 متتاليتين.	التوقف بعد خمس درجات صفر متتالية.	من الفقرة 1 الى 4 (0 أو 1) من الفقرة 5 الى 32 (0، 1، 2) يراجع أمثلة الأجوبة في دليل التطبيق والتصحيح.

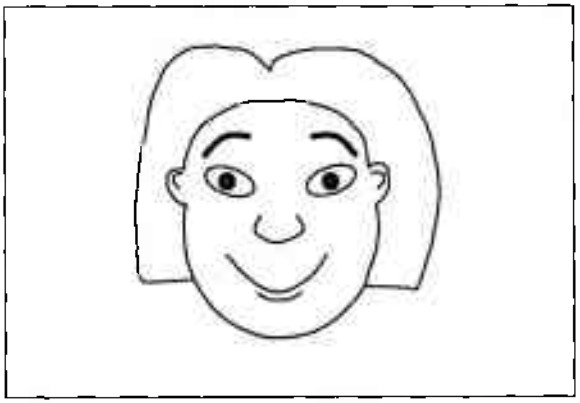
	الفقرة	الإجابة	الدرجة		
	الفقرات الصورية				
	1. سيارة		0	1	
	2. زهرة		0	1	
	3. بقرة		0	1	
	4. مظلة / شمسية		0	1	
	الفقرات الشفهية				
8-6	**5. طاقية**		0	1	2
	6. قطار		0	1	2
11-9	**7. سارق**		0	1	2
	8. دلو		0	1	2
16-12	**9. ساعة حائط**		0	1	2
	10. شجاع		0	1	2
	11. شاحنة		0	1	2
	12. قديم		0	1	2
	13. رحيل		0	1	2
	14. مزعج		0	1	2
	15. الحروف الأبجدية		0	1	2
	16. مطيع		0	1	2
	17. كلام فارغ		0	1	2
	18. هجرة		0	1	2
	19. شفاف		0	1	2
	20. منافسة		0	1	2
	21. نادر		0	1	2

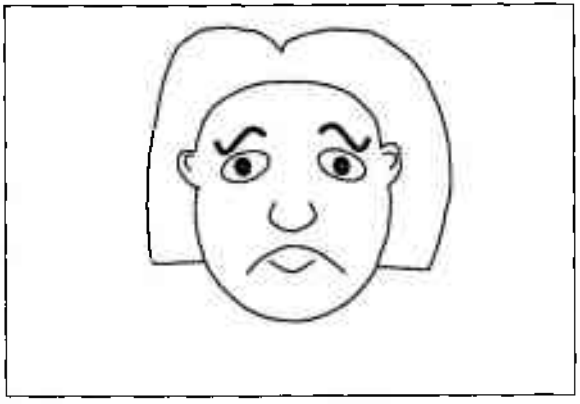
يتبع

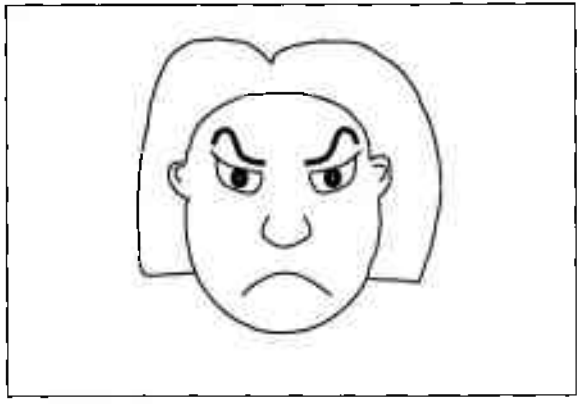


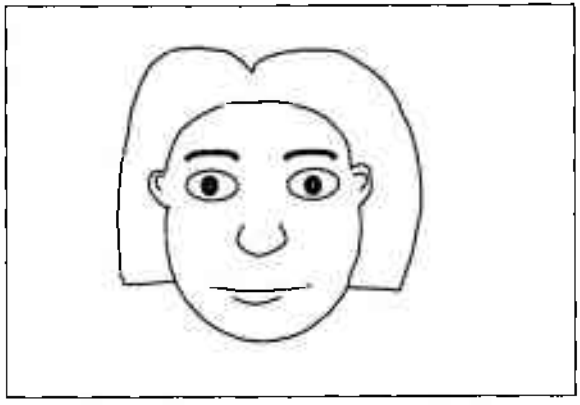


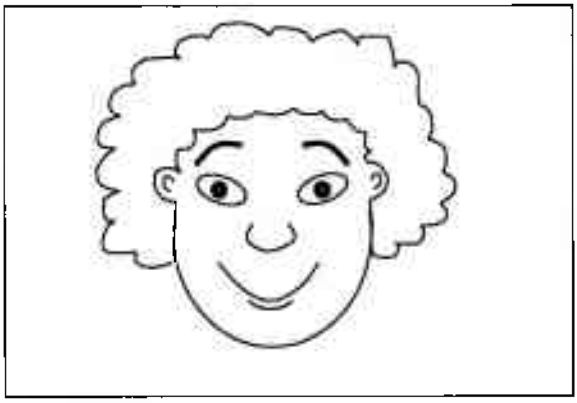


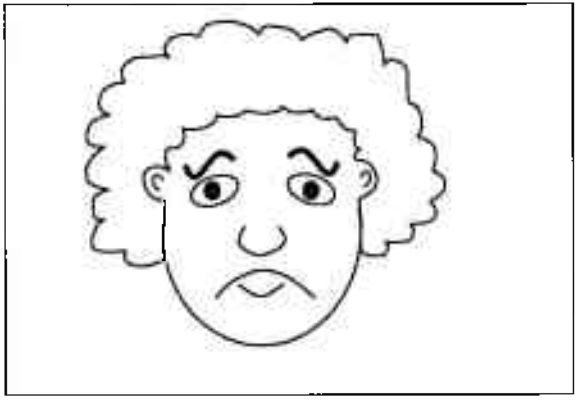


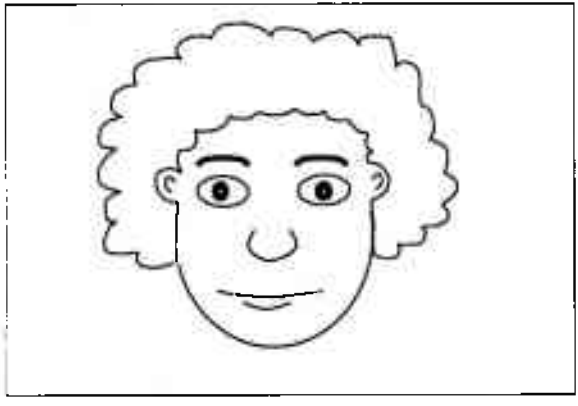


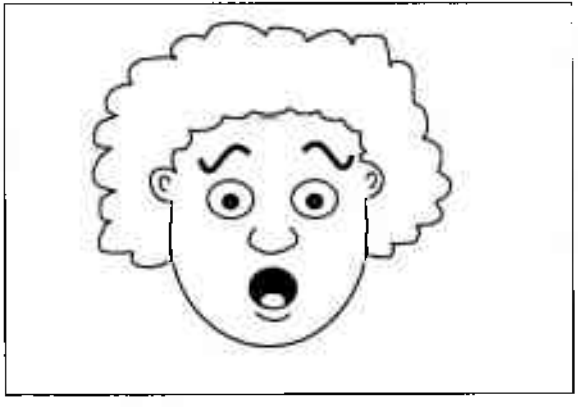


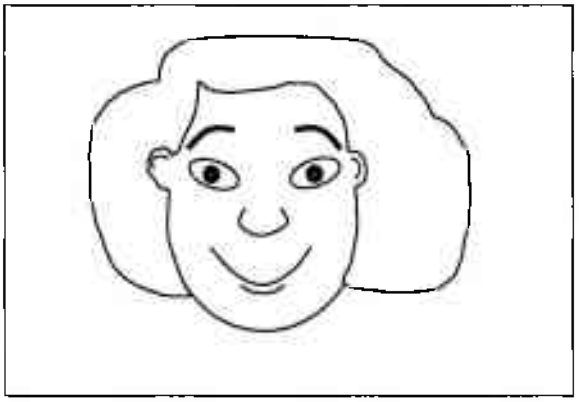


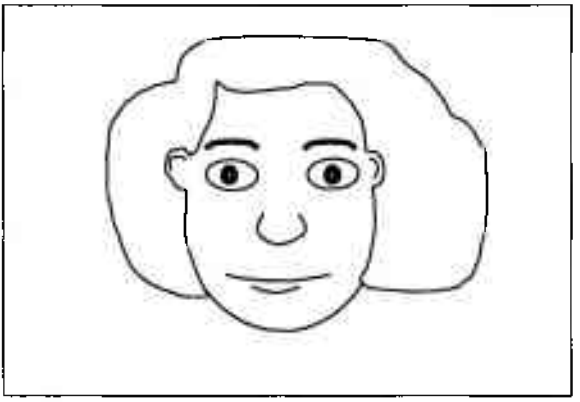


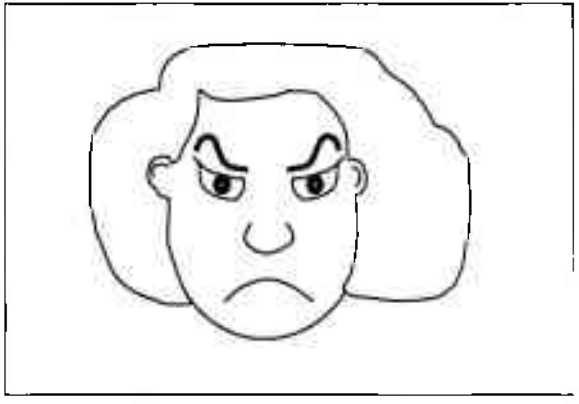


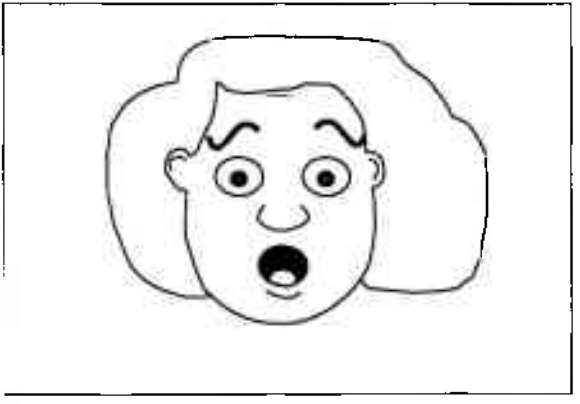


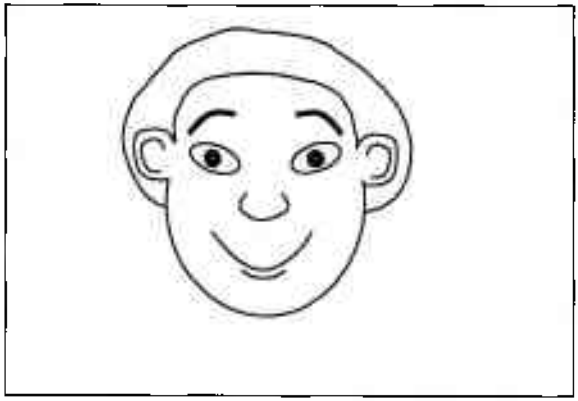


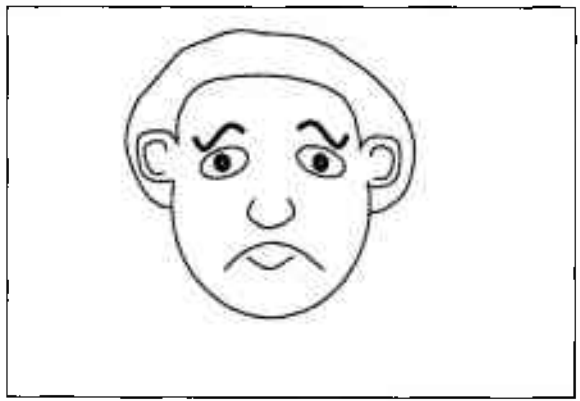


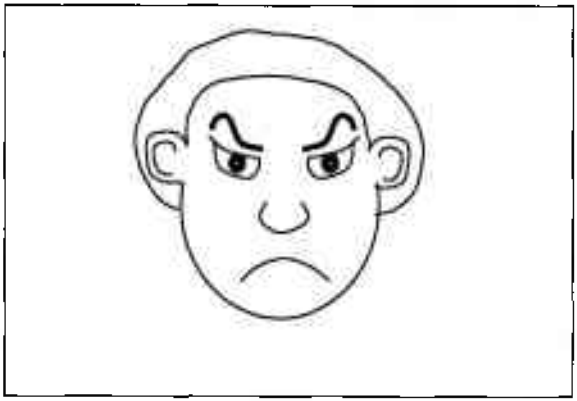


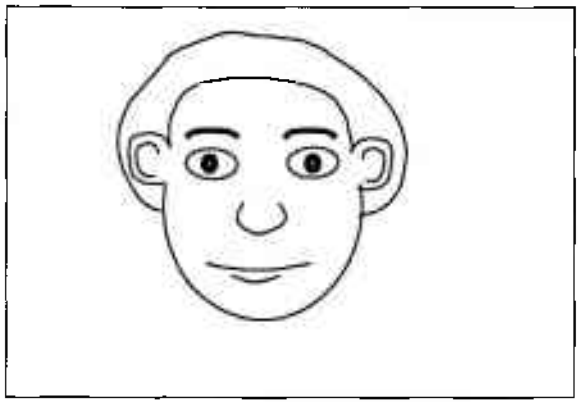


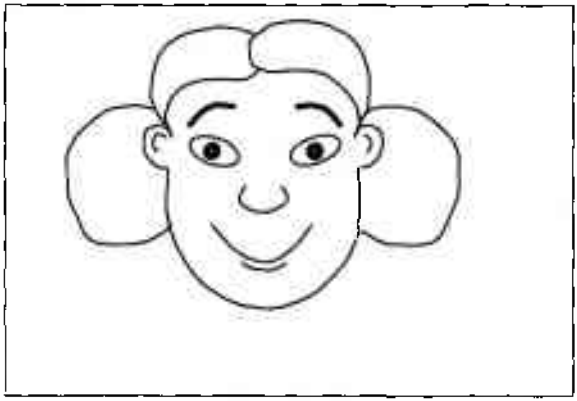


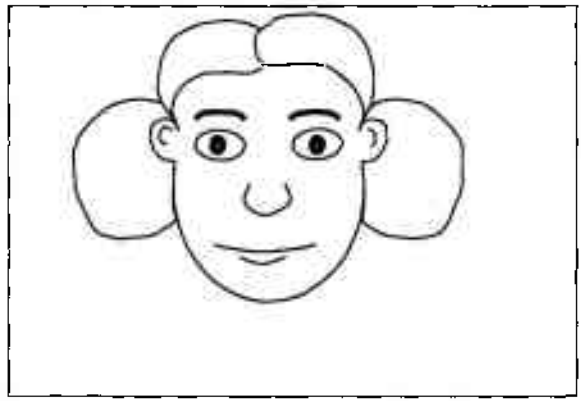


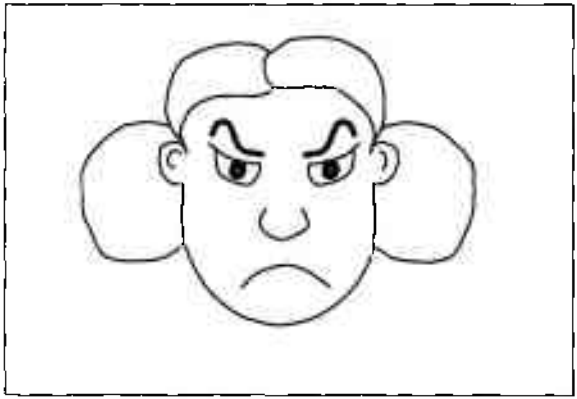


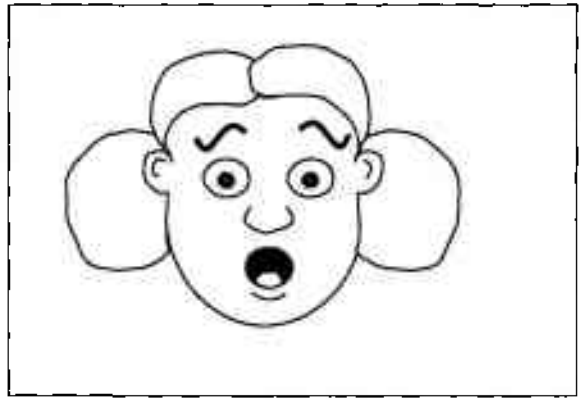


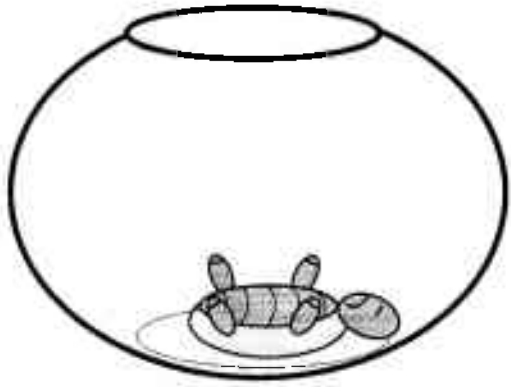


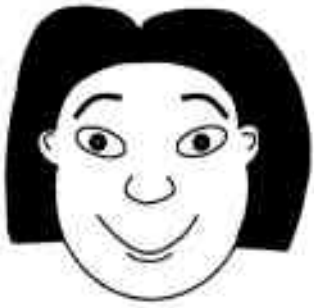


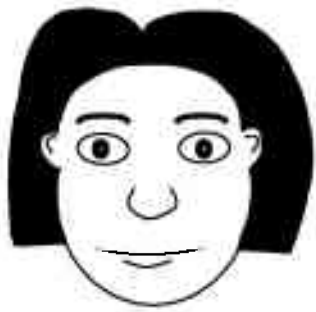


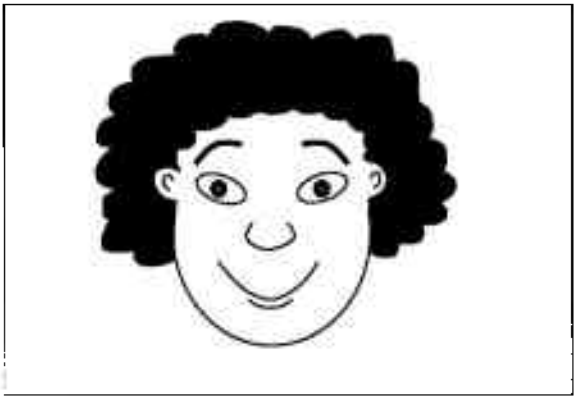


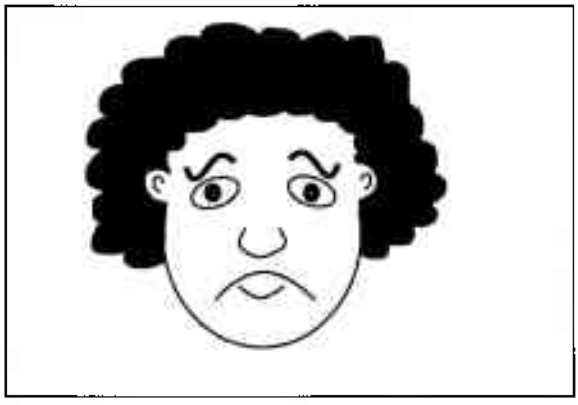


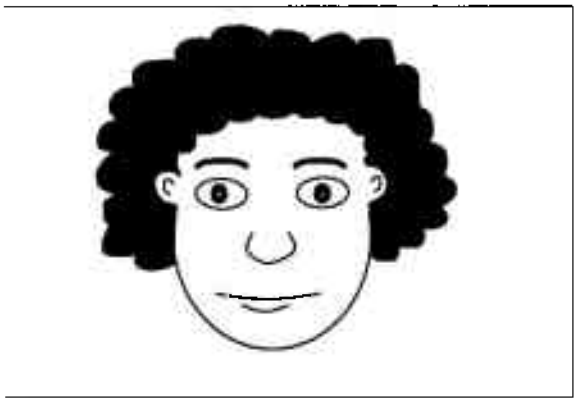


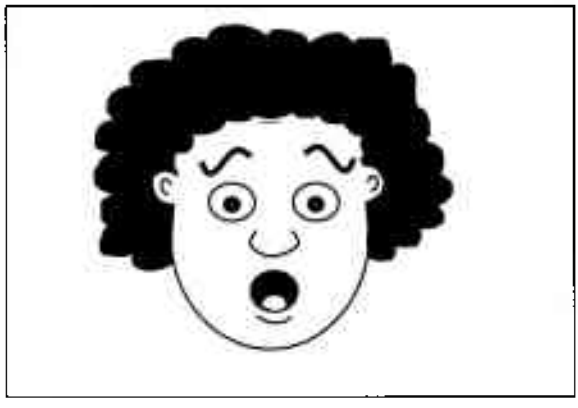


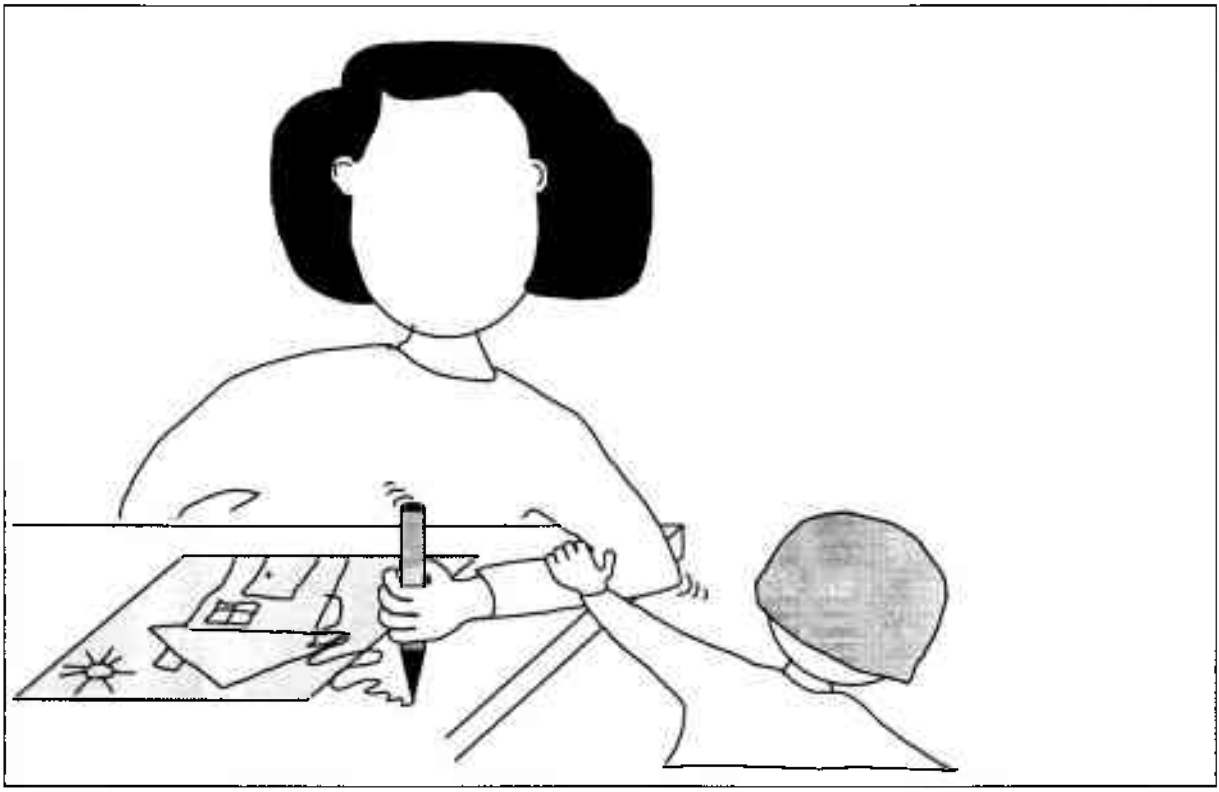


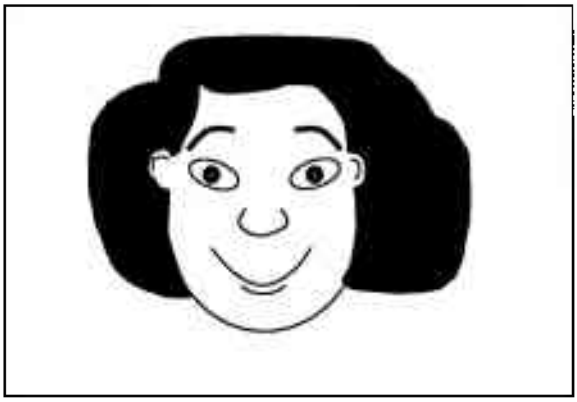


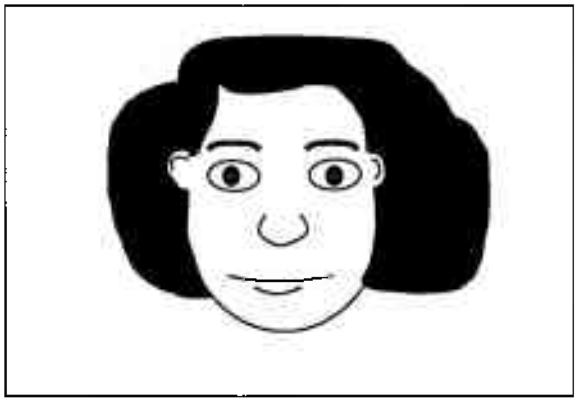


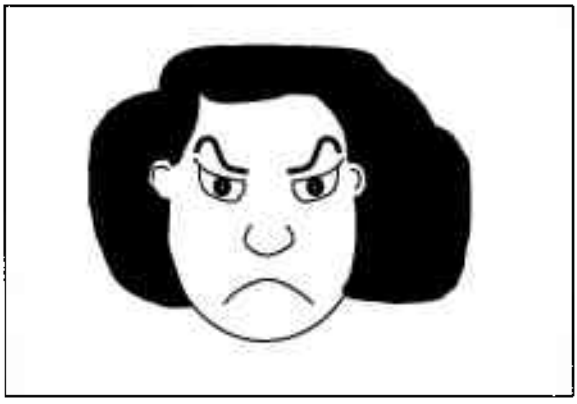


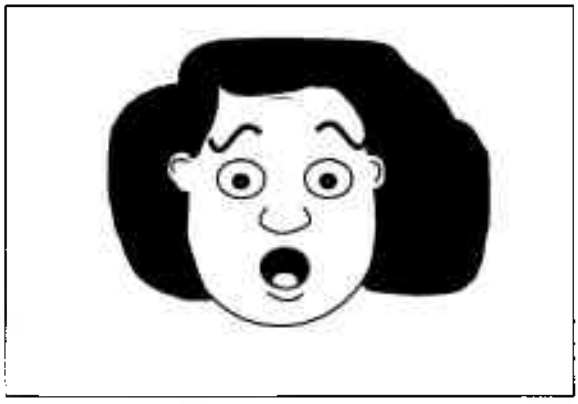


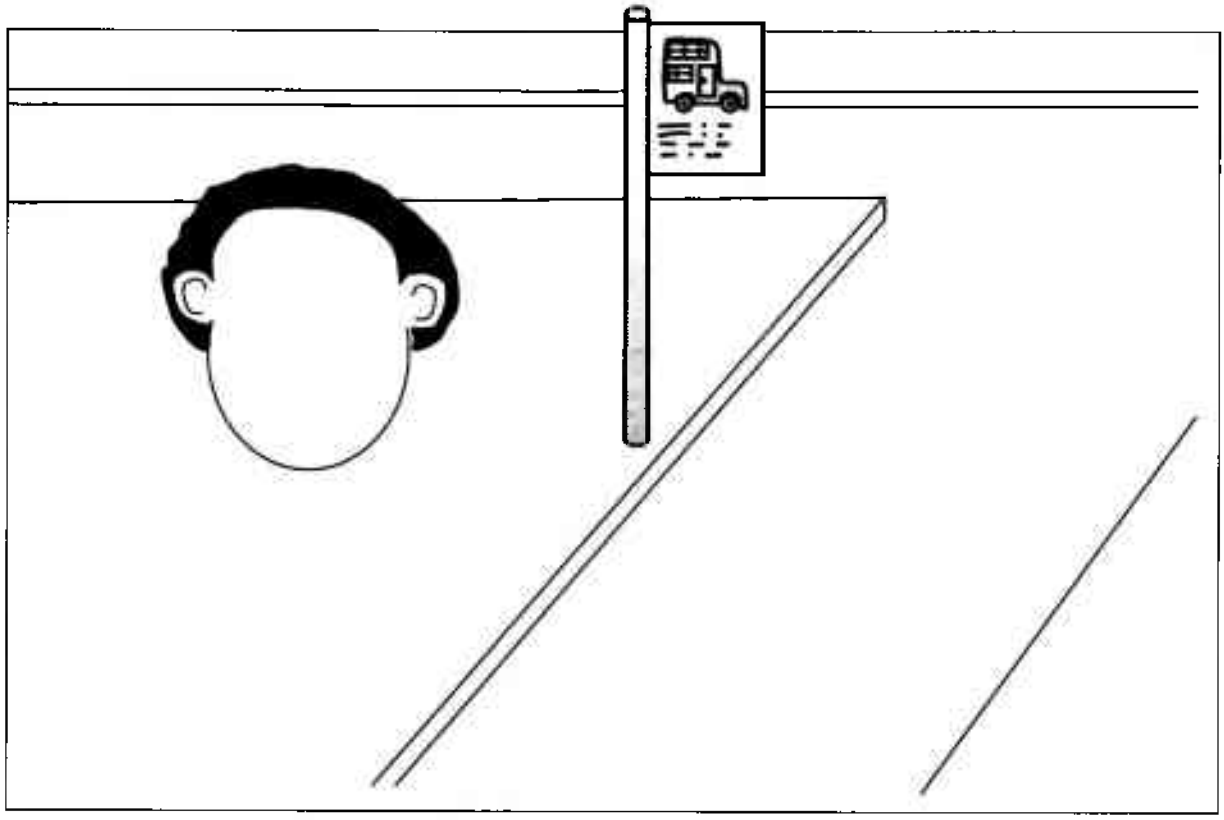


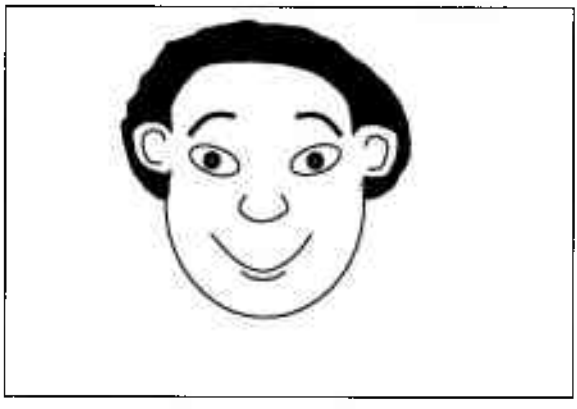


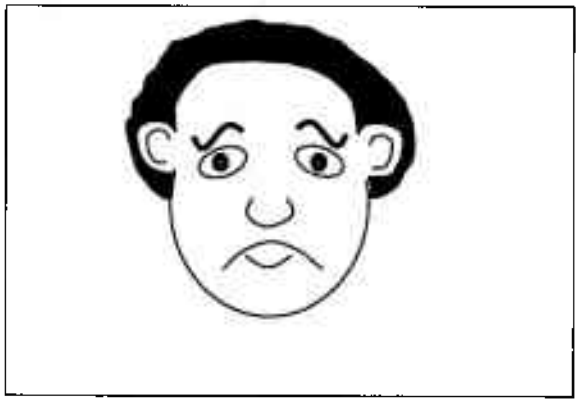


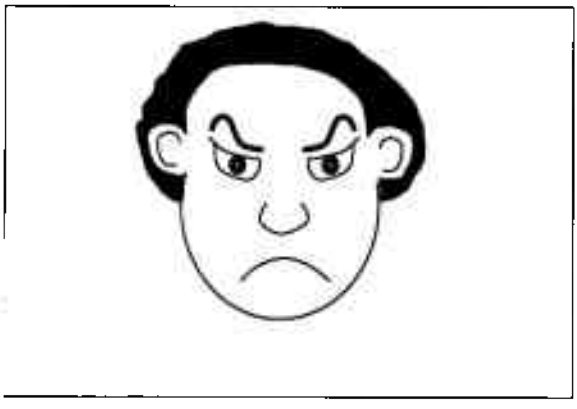


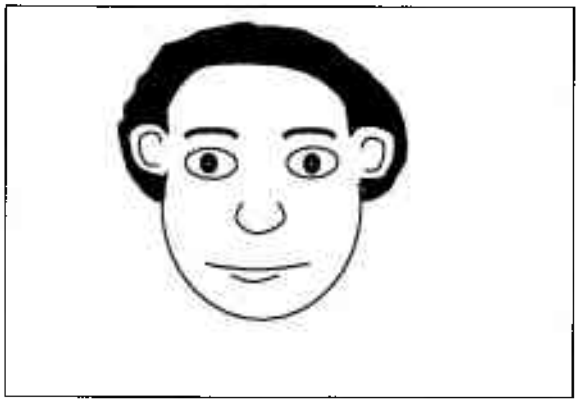


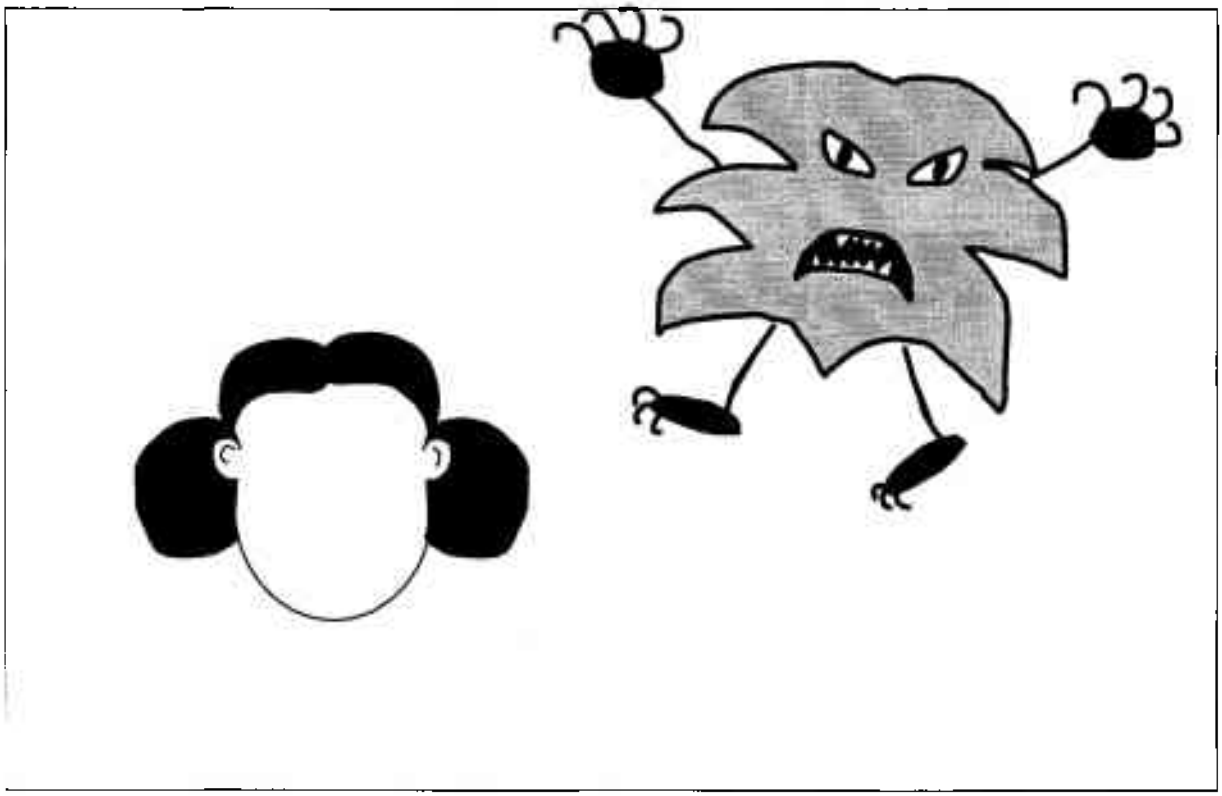


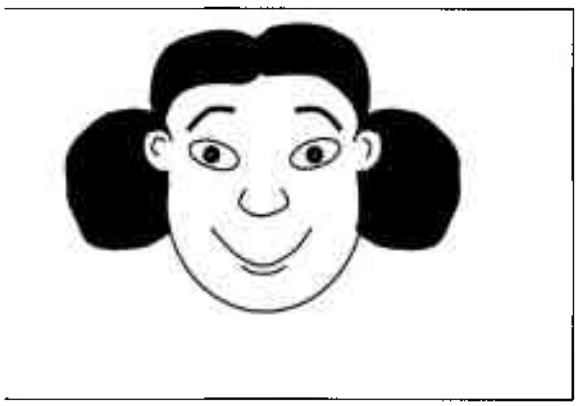


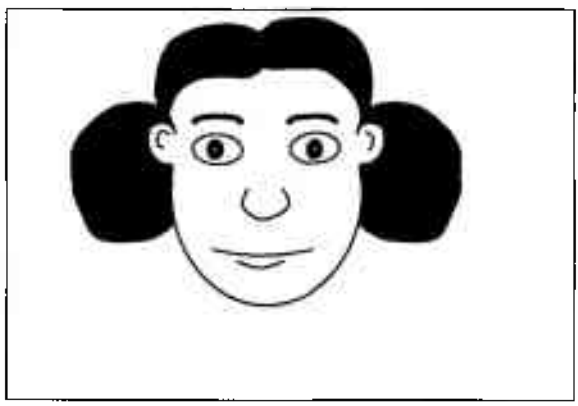


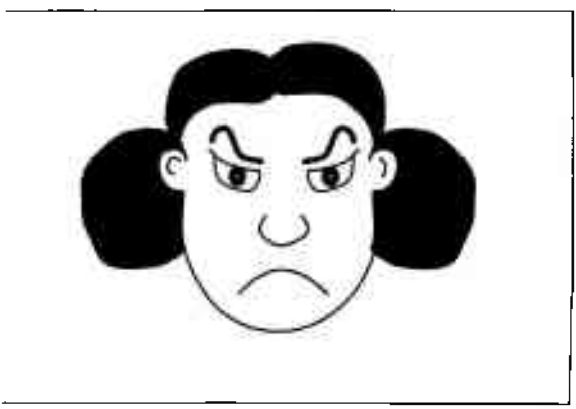


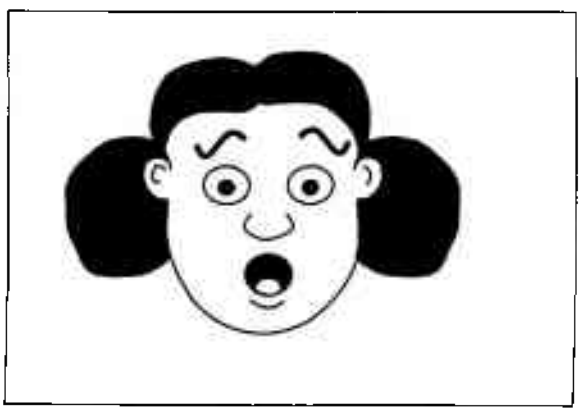


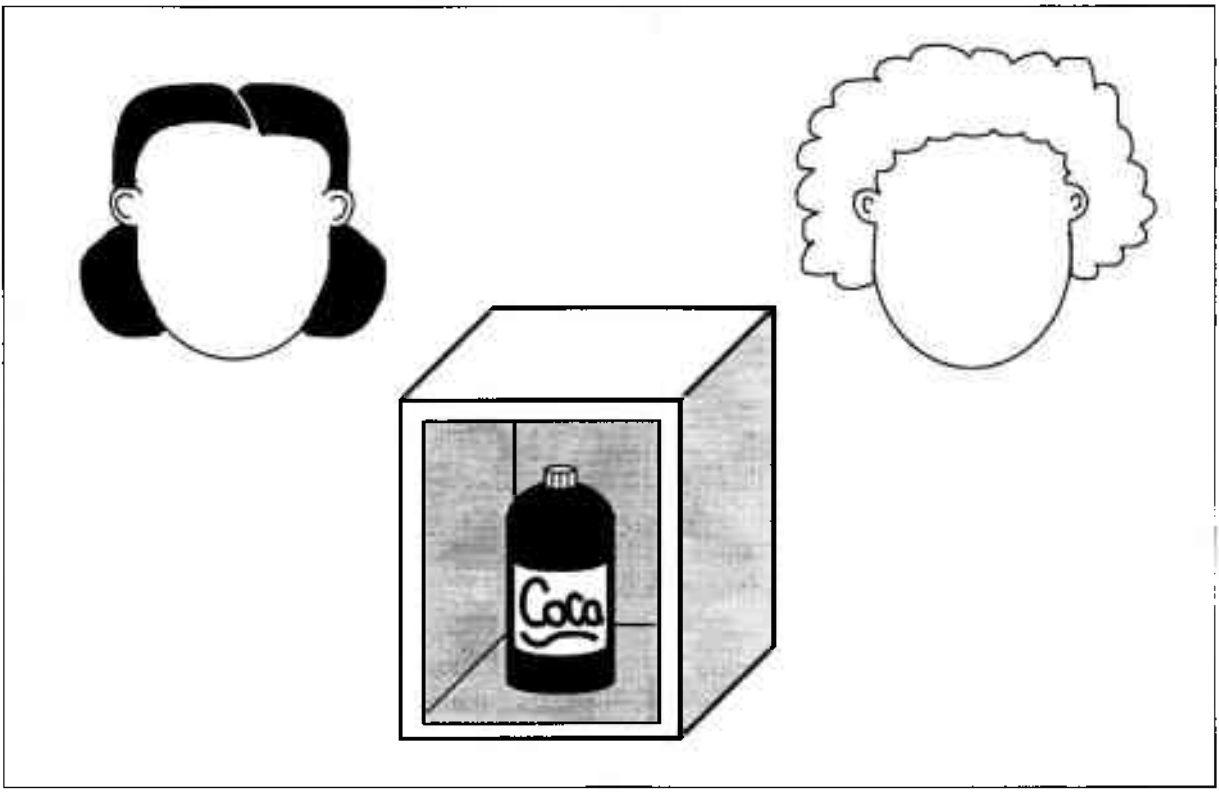








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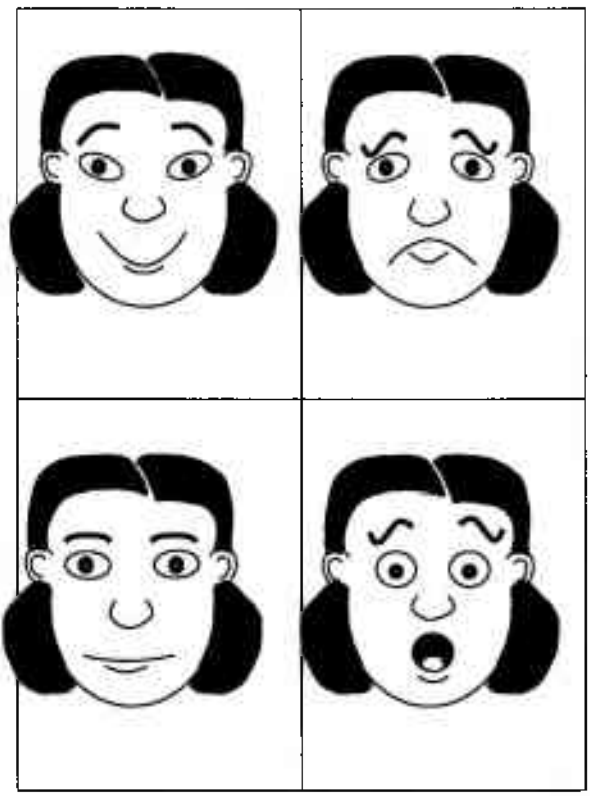

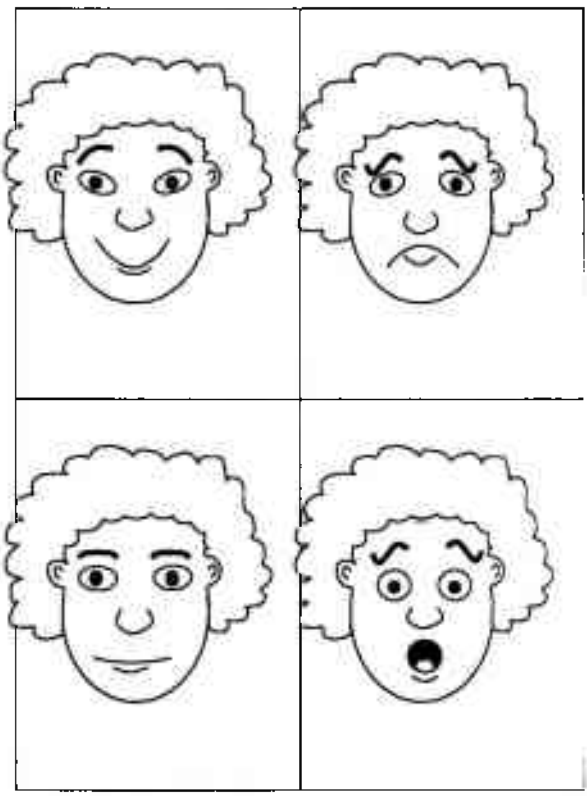

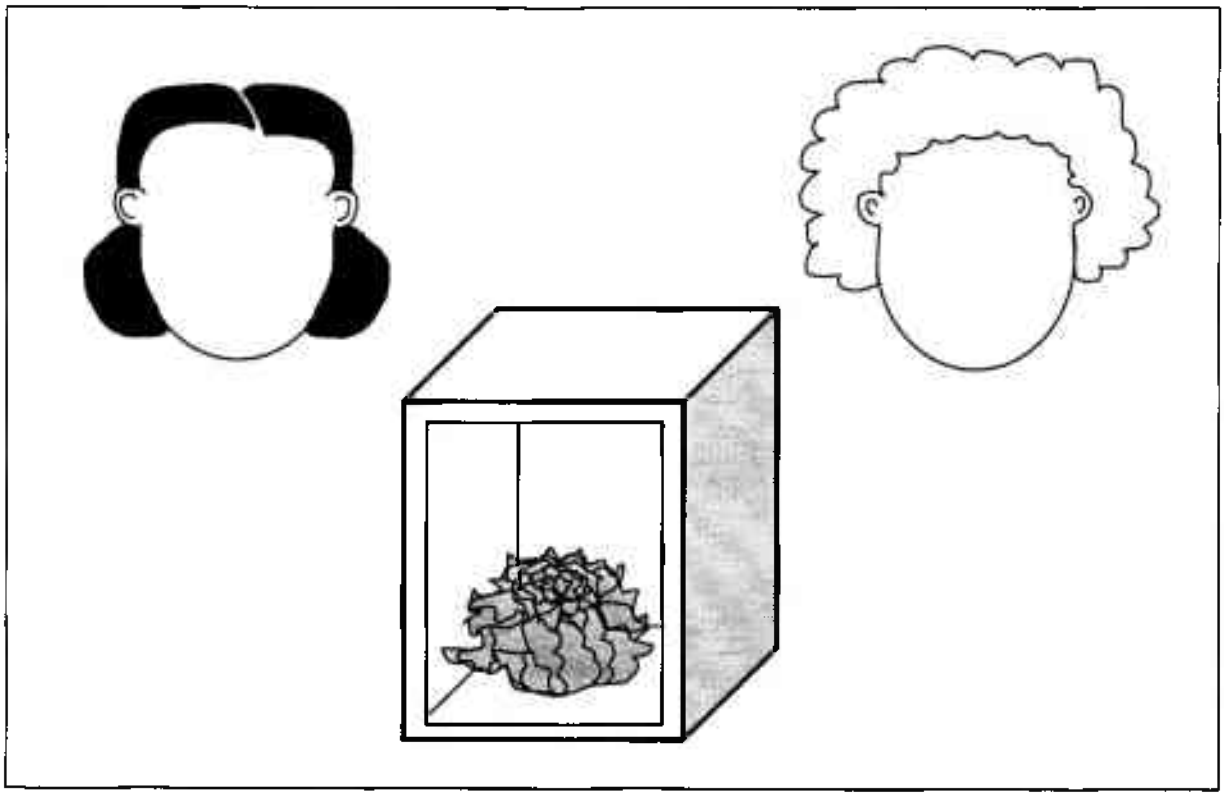

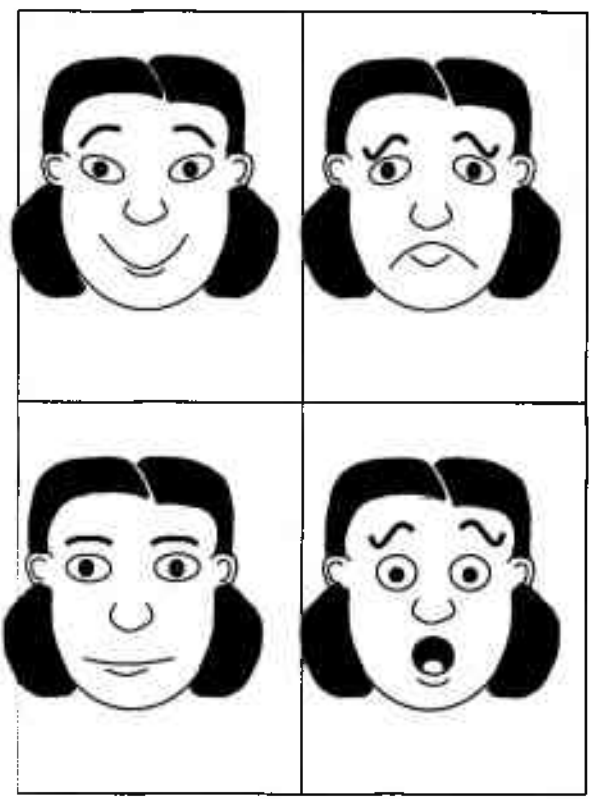

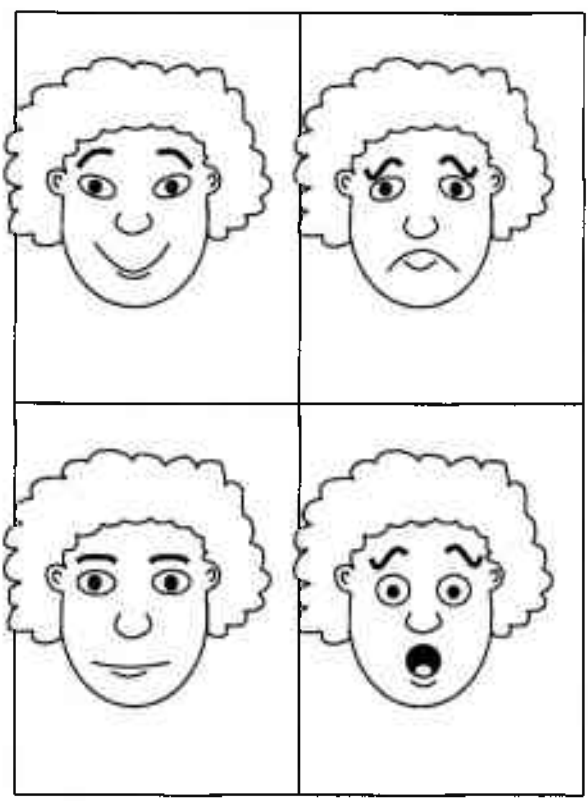

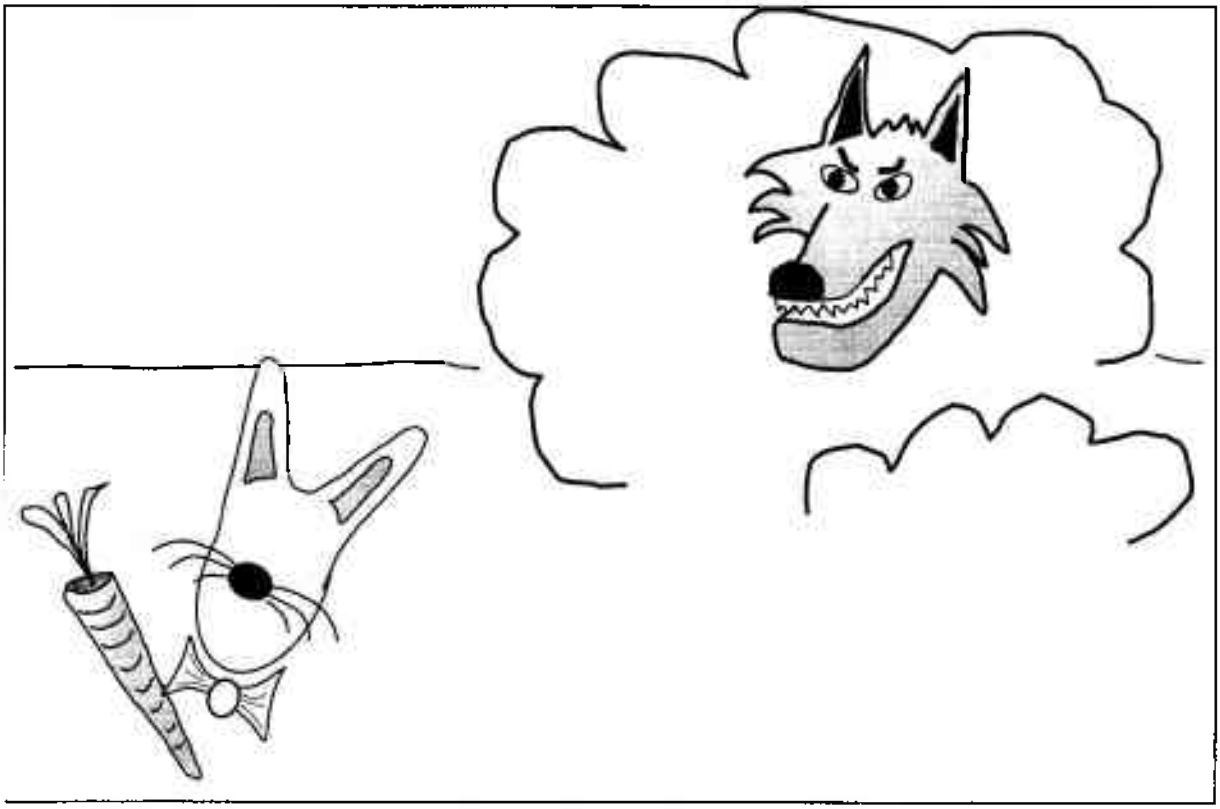

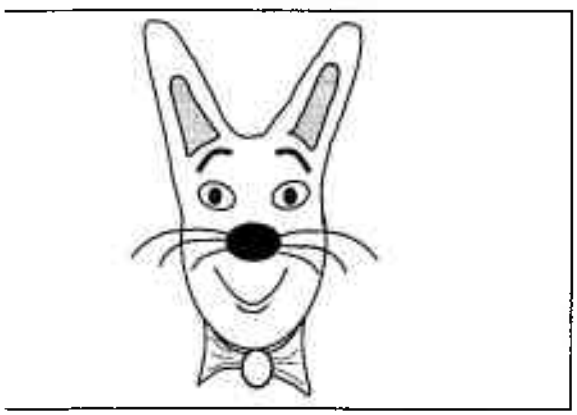

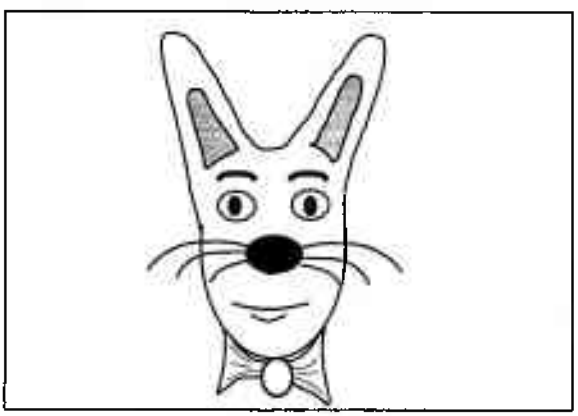

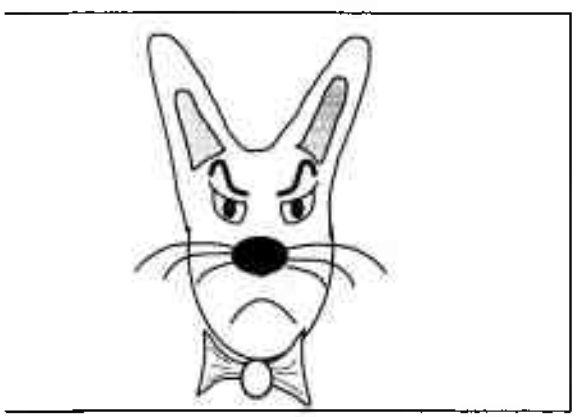

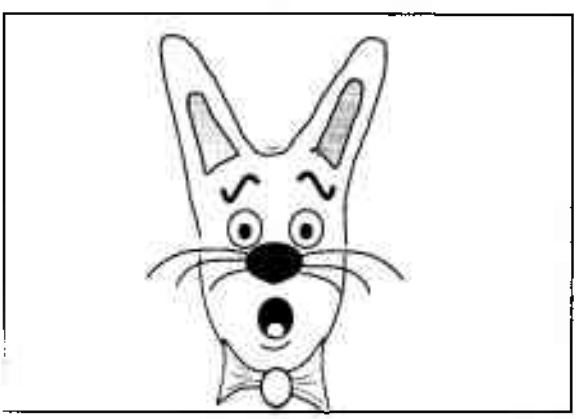

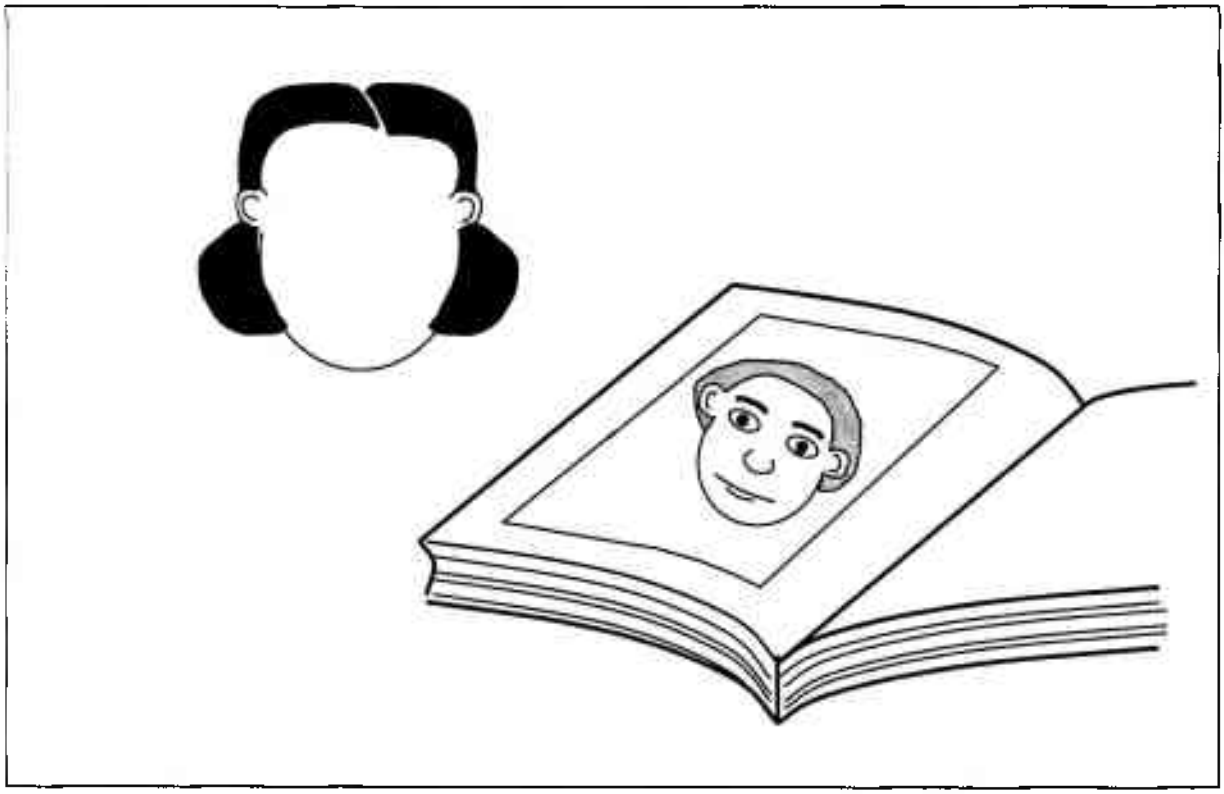

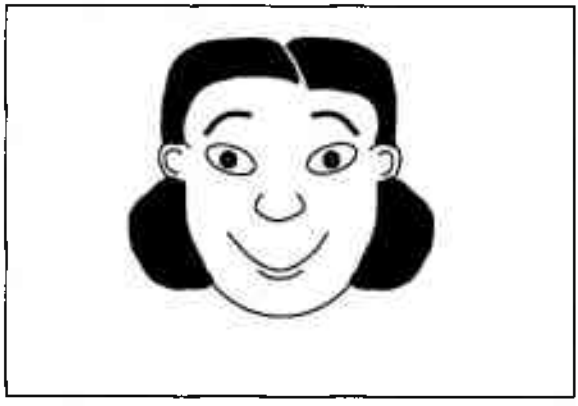

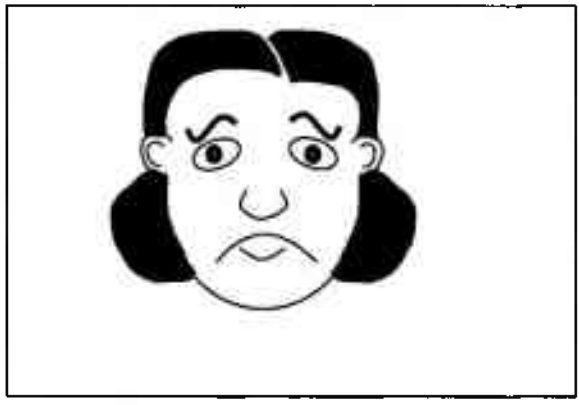

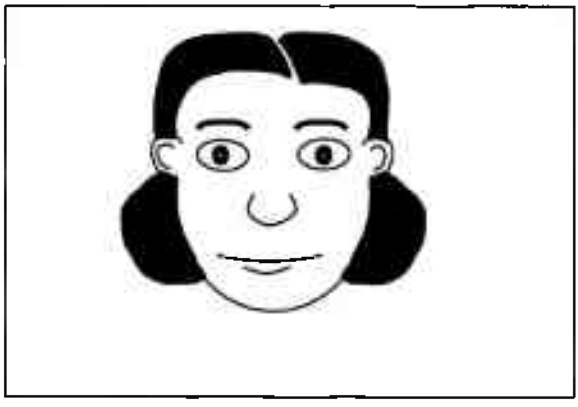

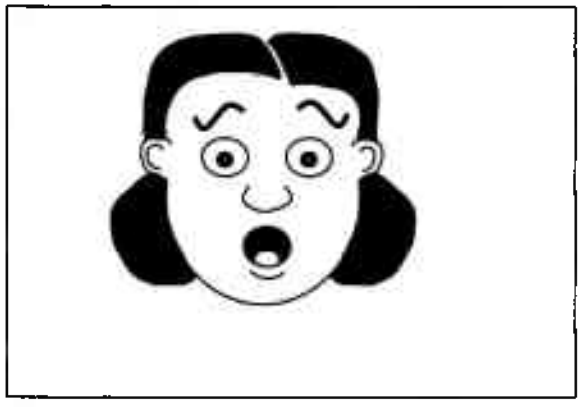

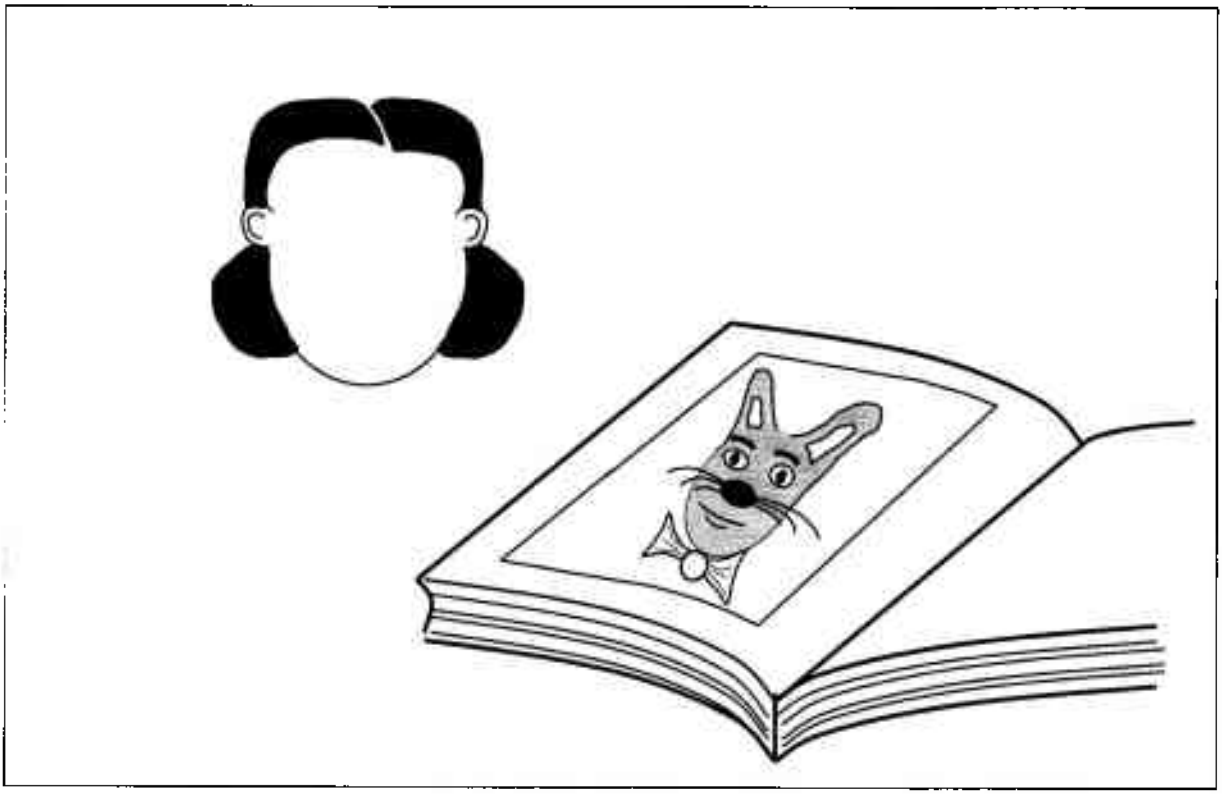

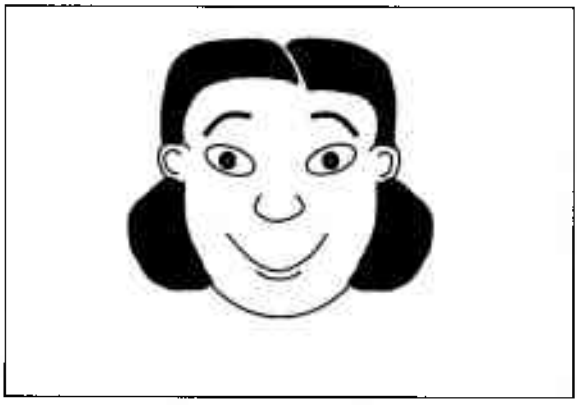

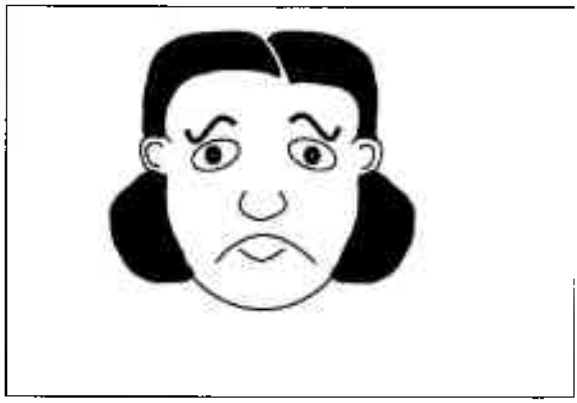

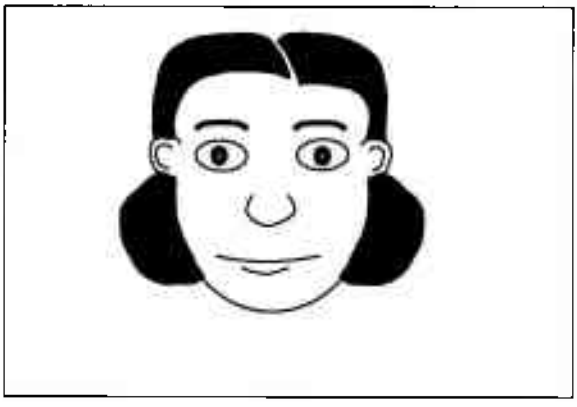

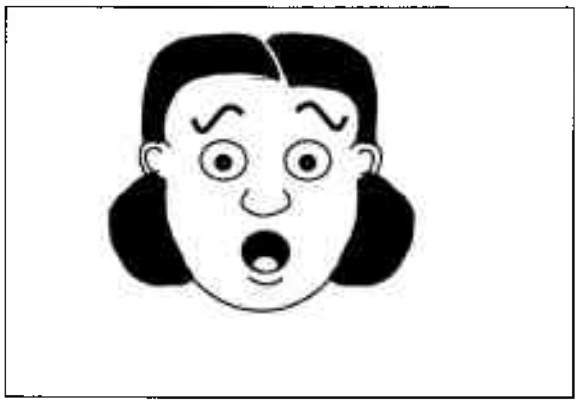

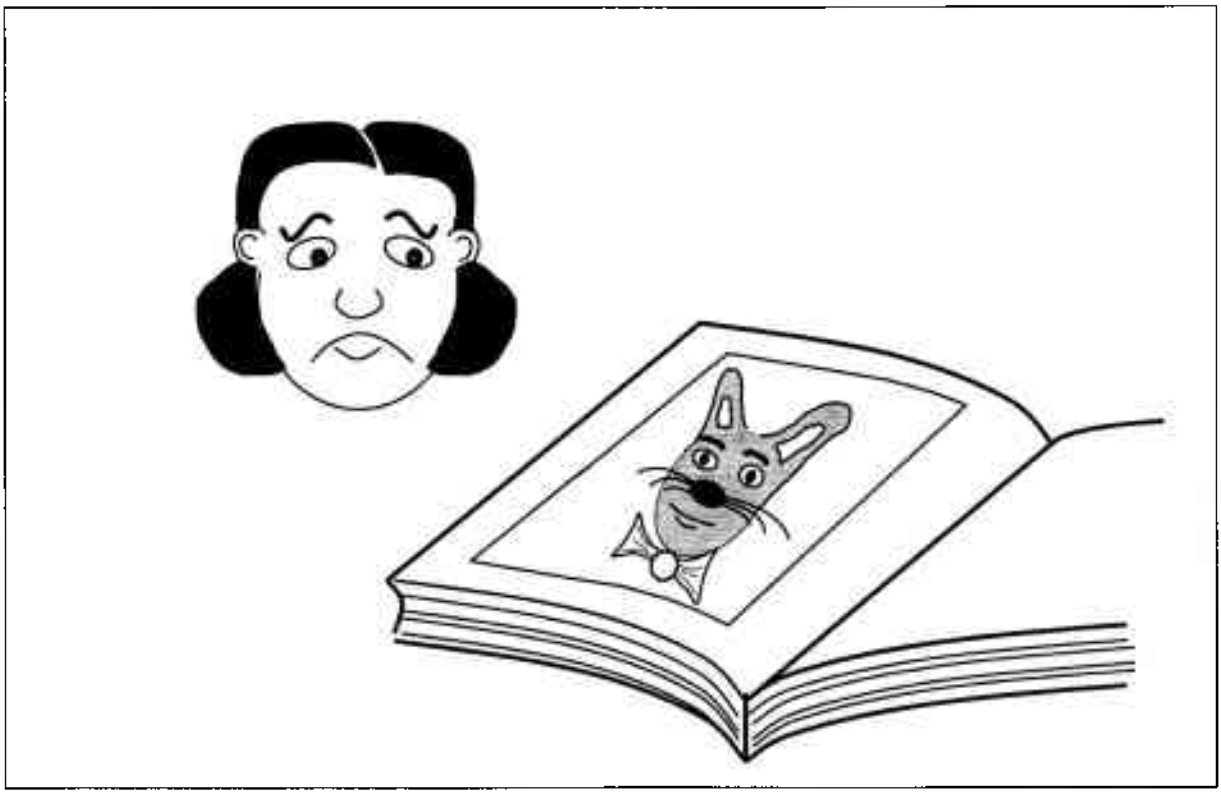

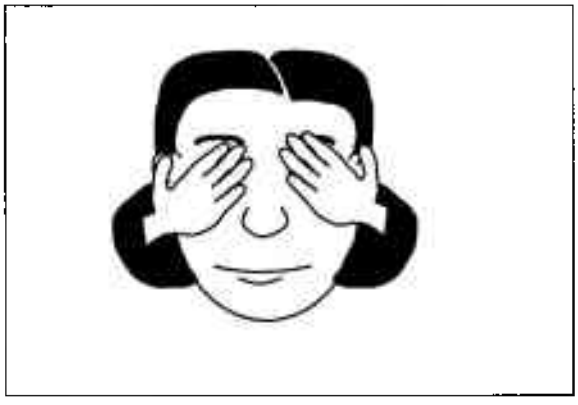

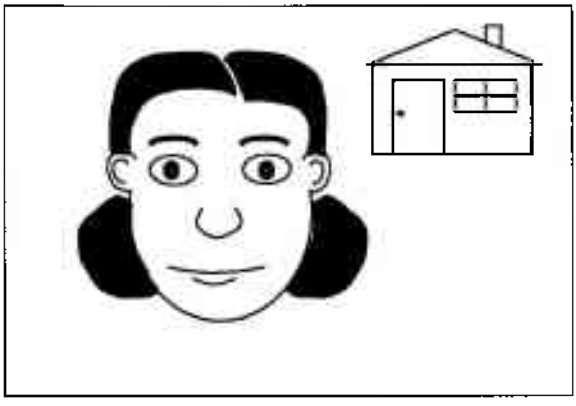

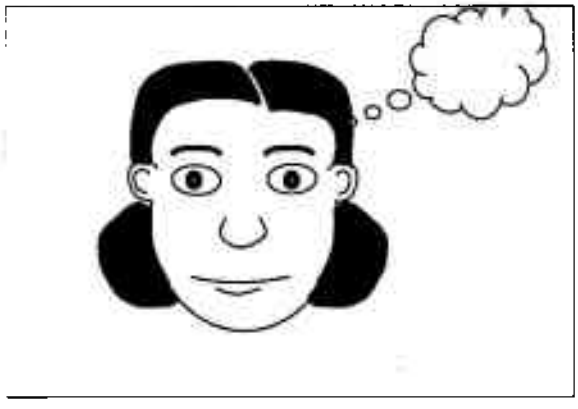

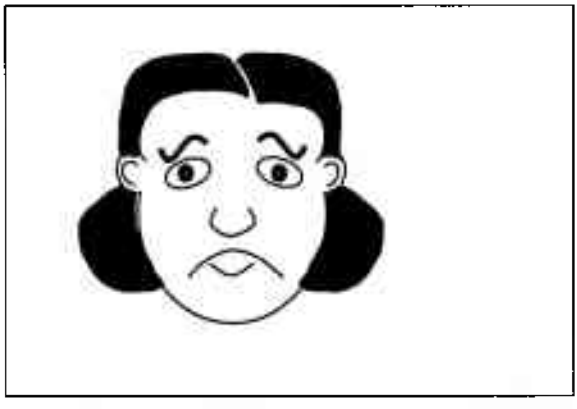

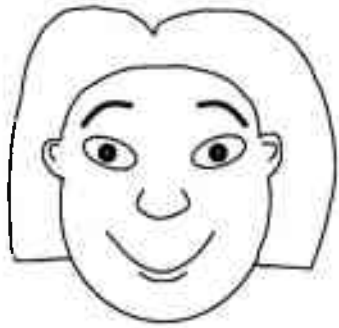

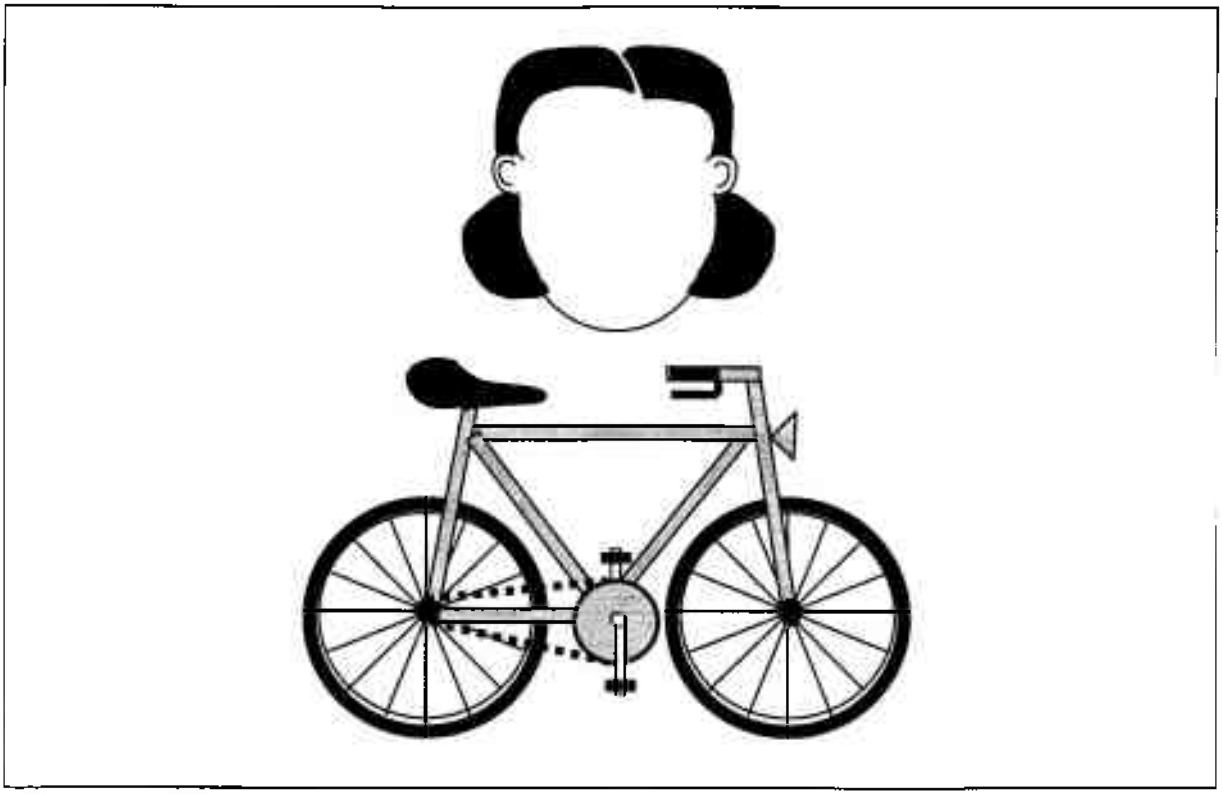

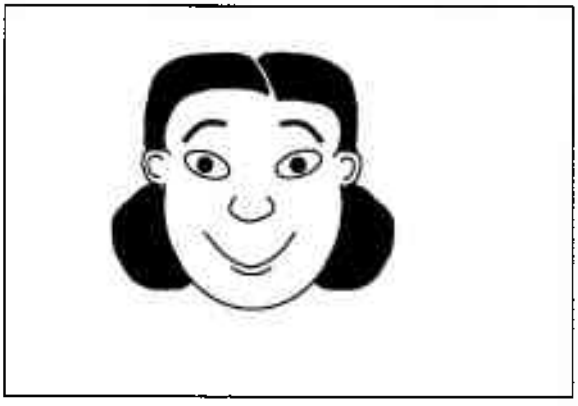

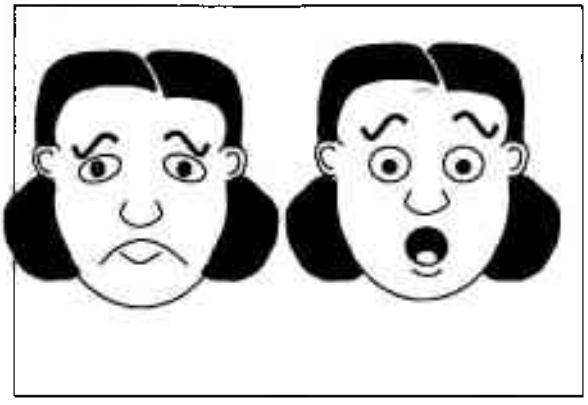

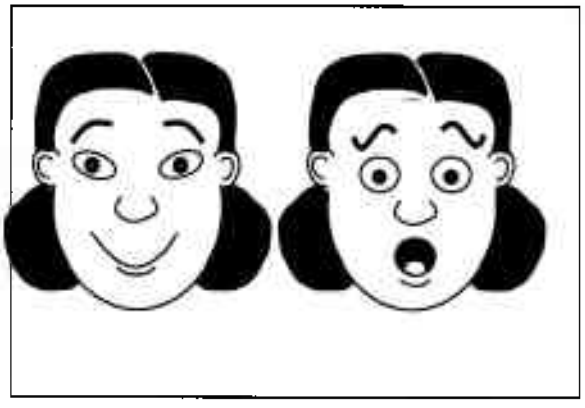

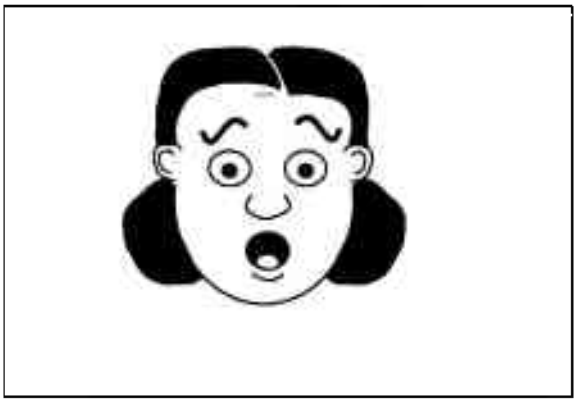

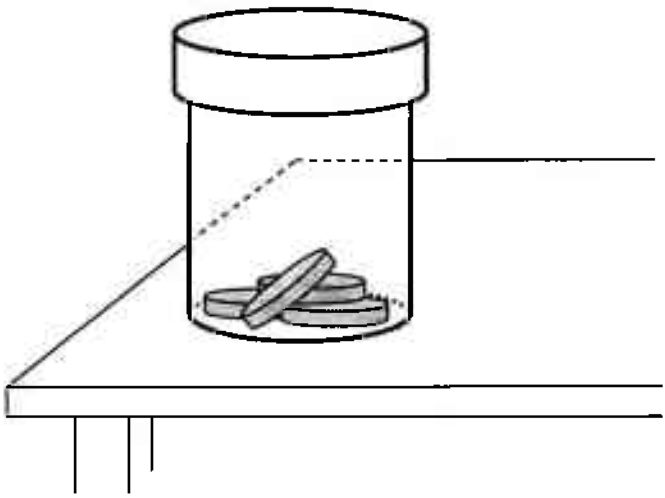

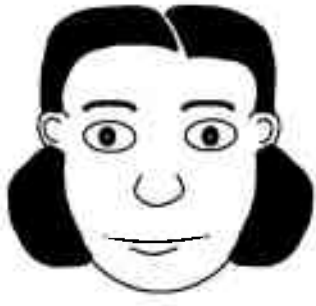

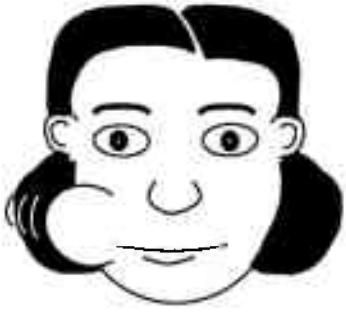

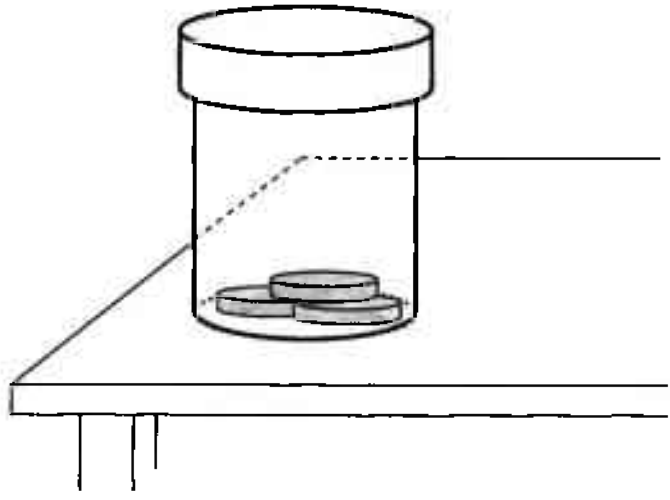

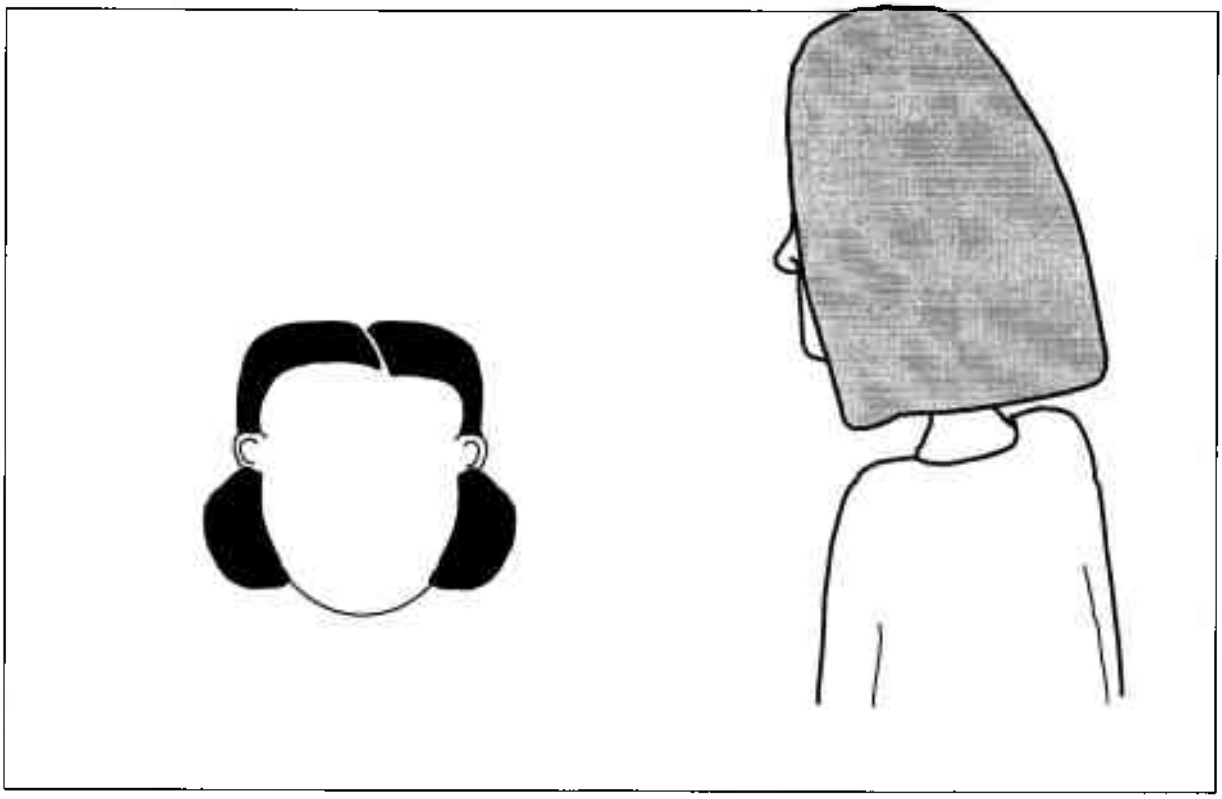

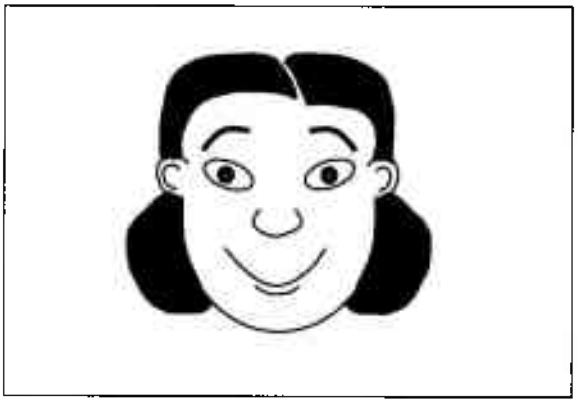

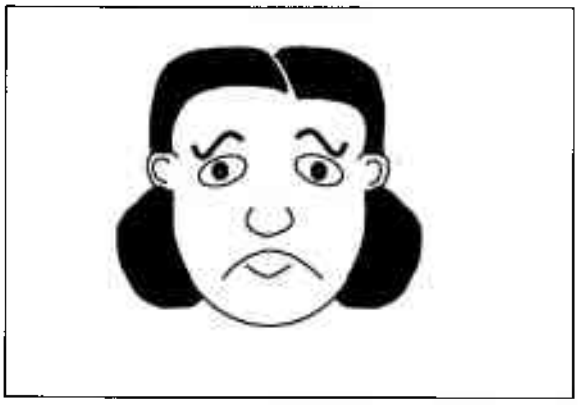

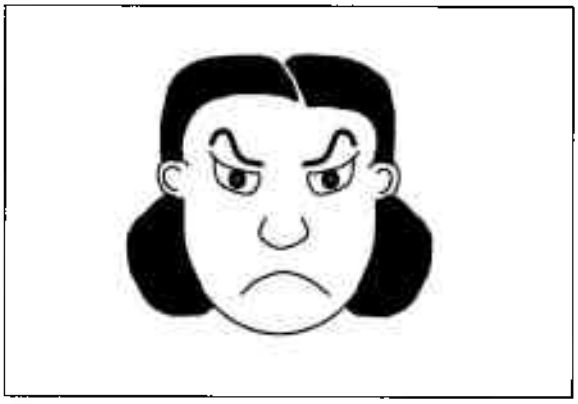

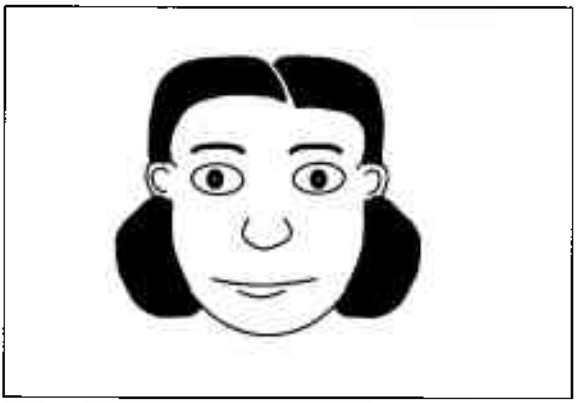

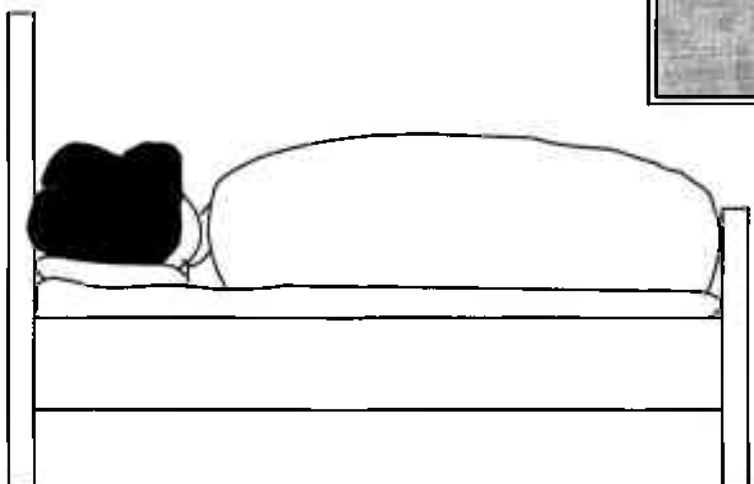

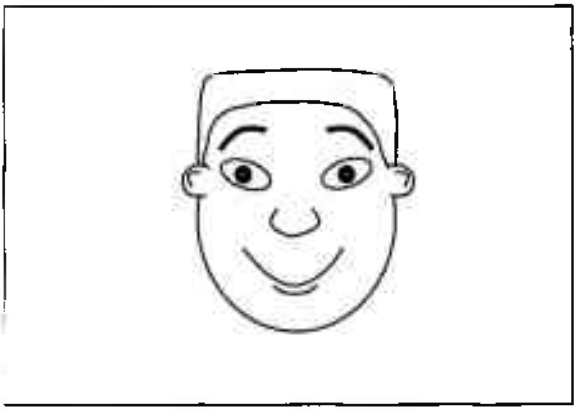

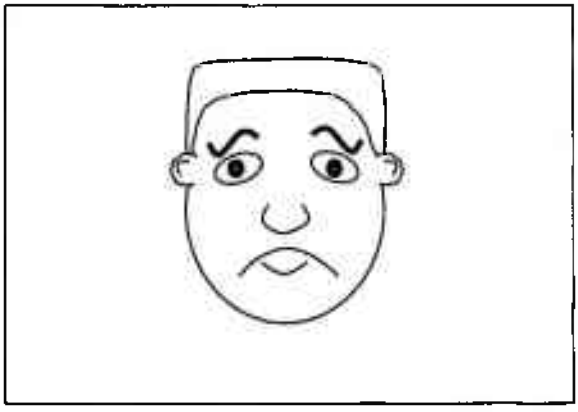

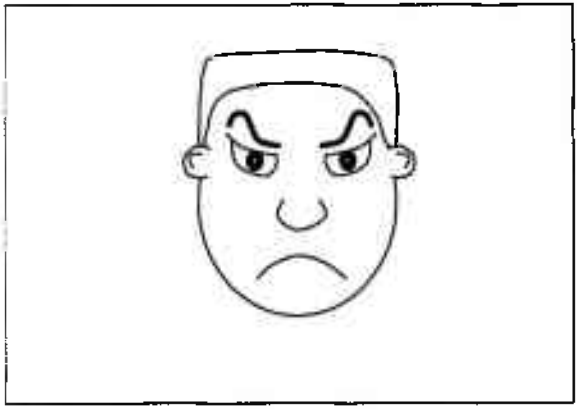

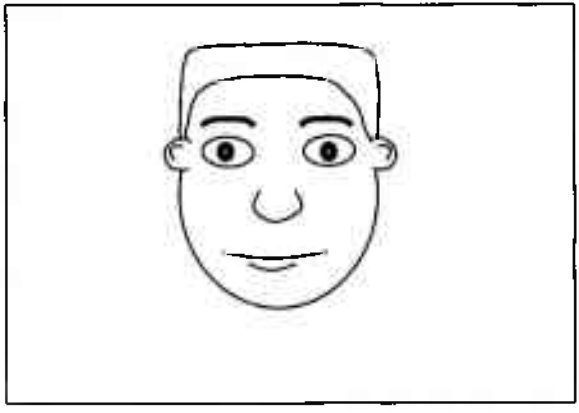

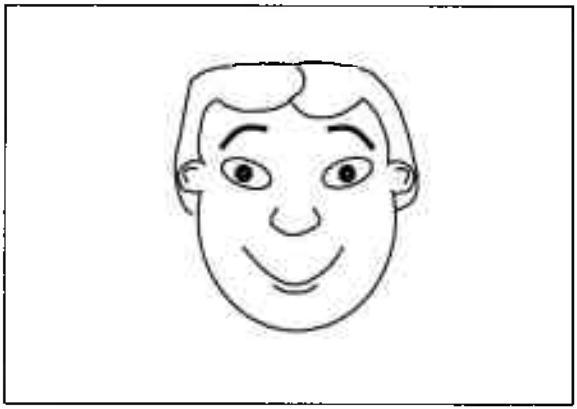

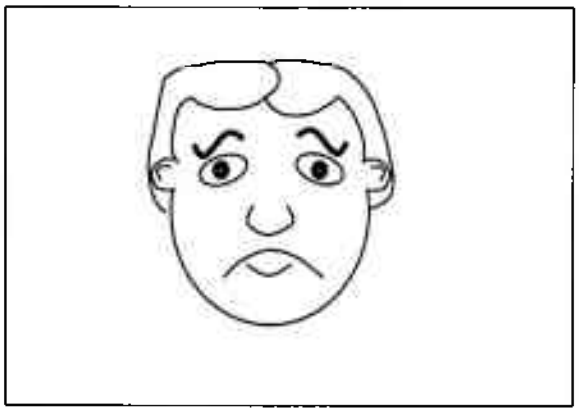

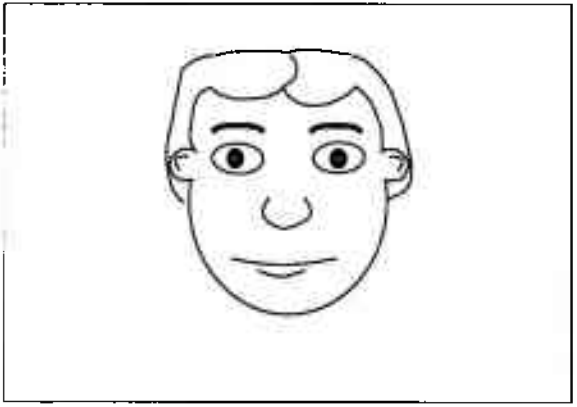

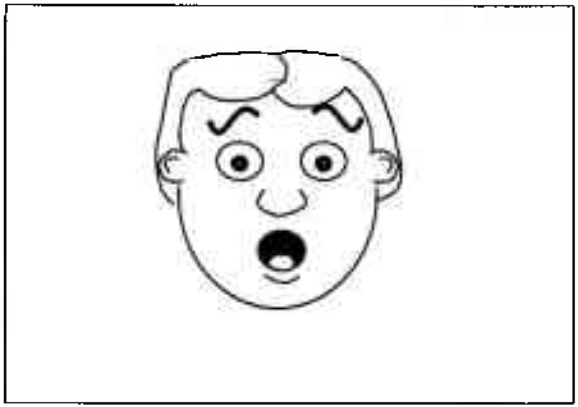

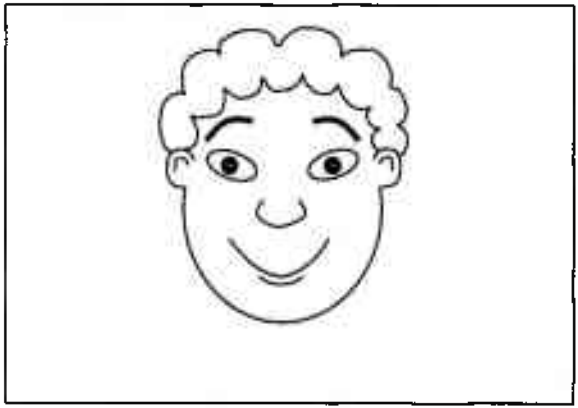

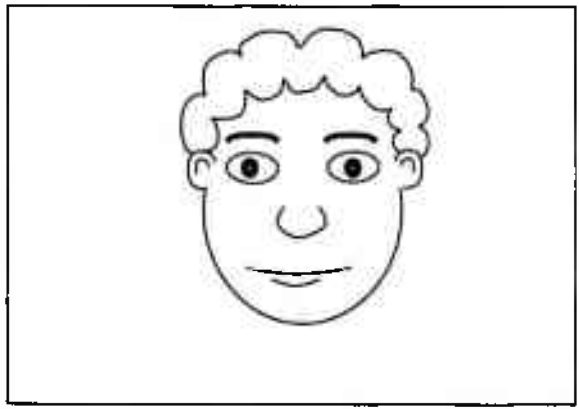

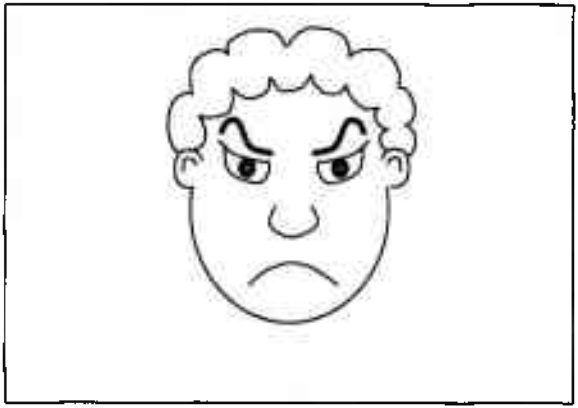

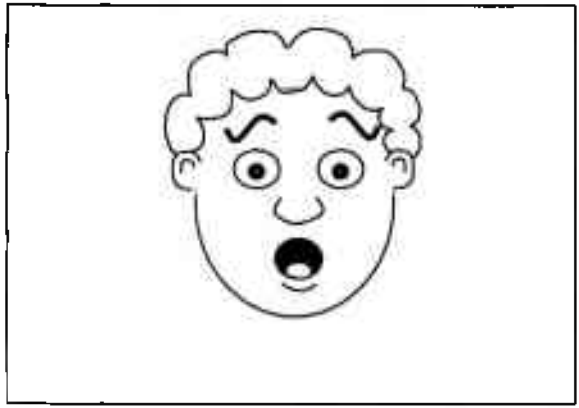

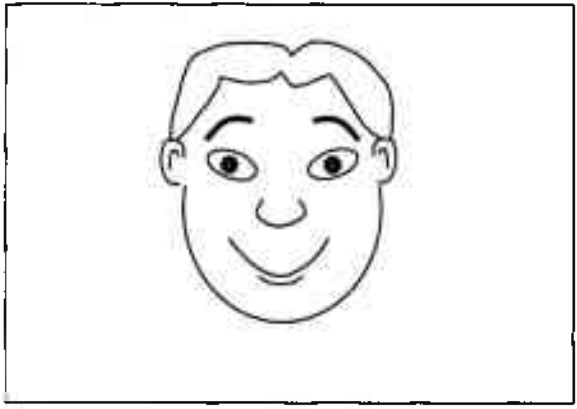

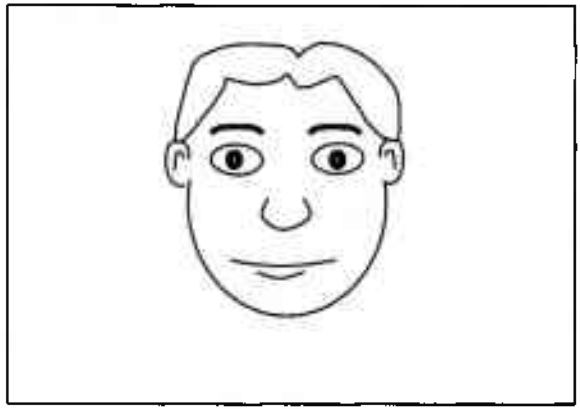

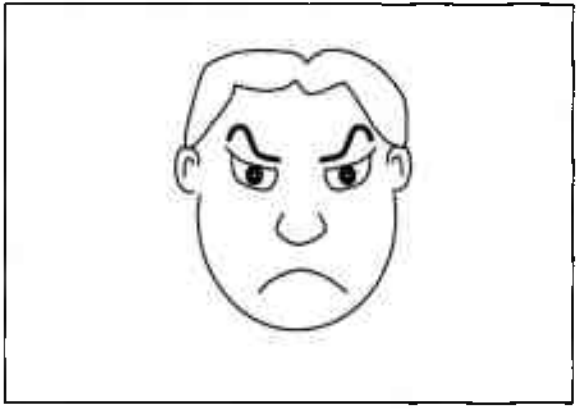

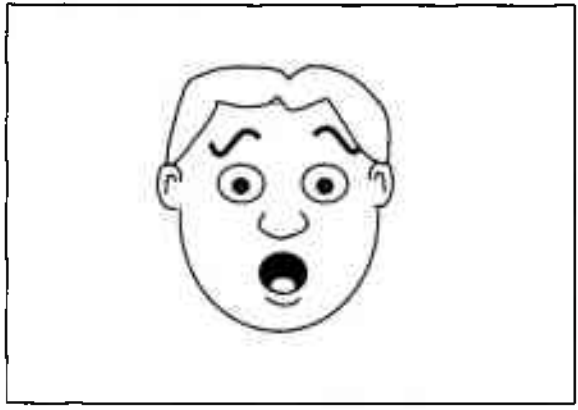

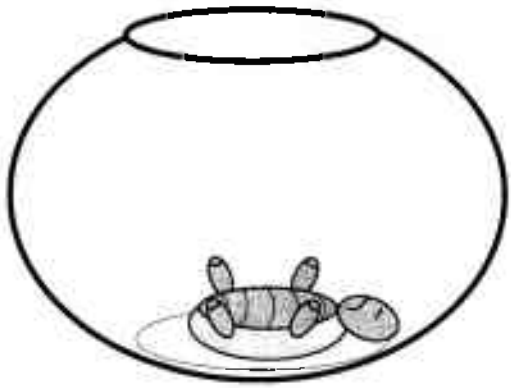

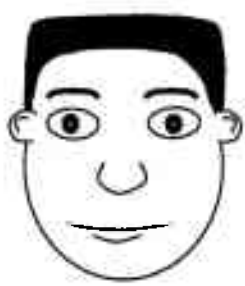

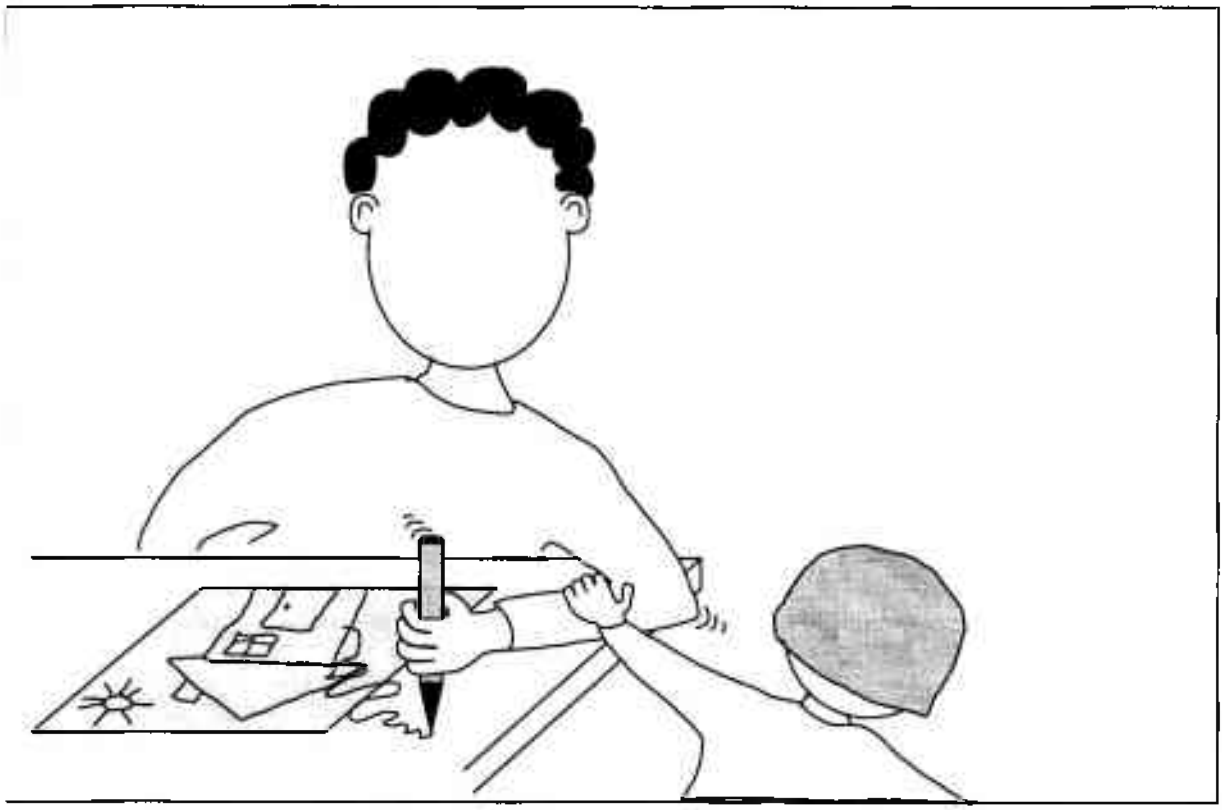

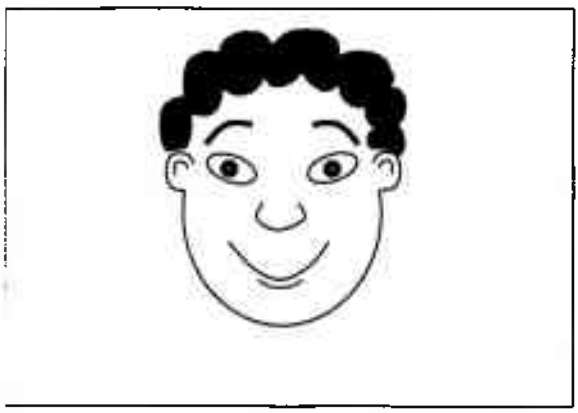

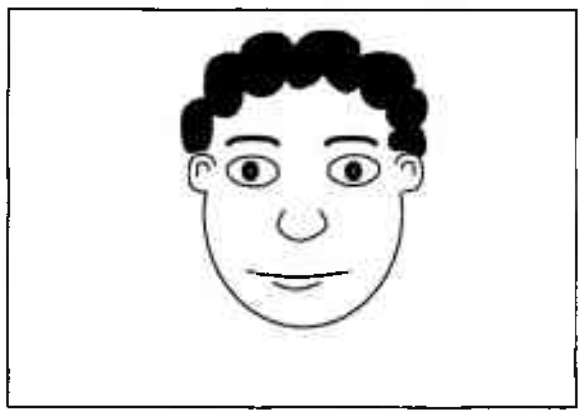

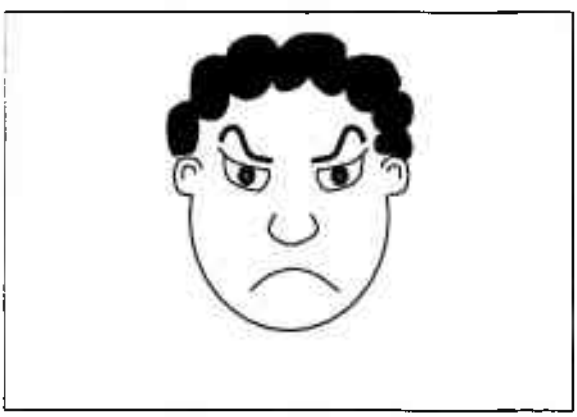

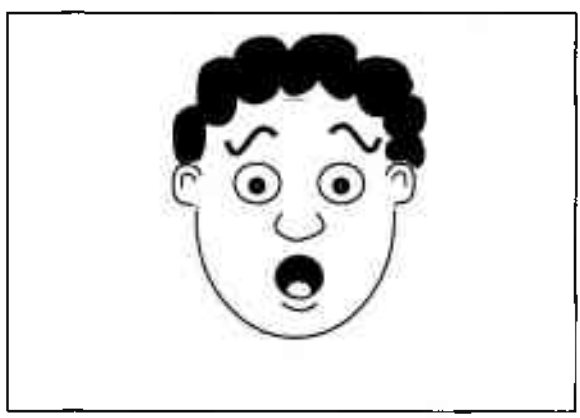

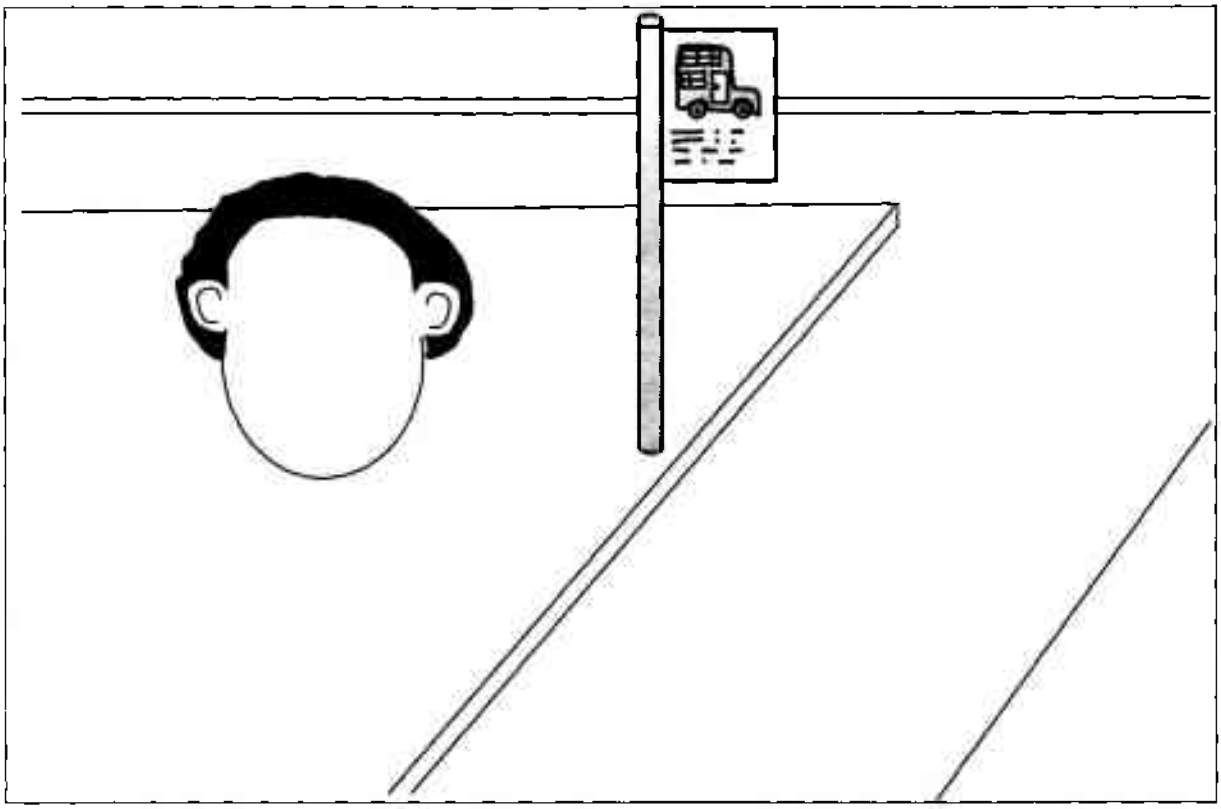

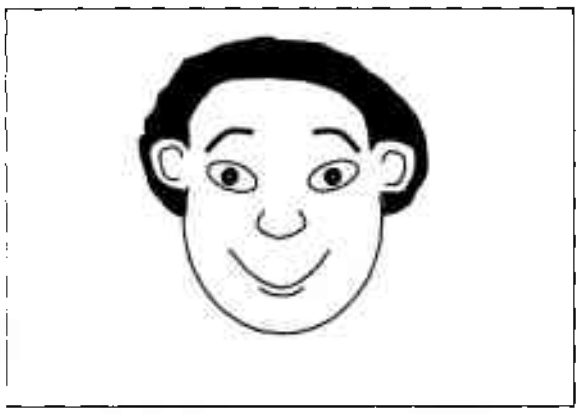

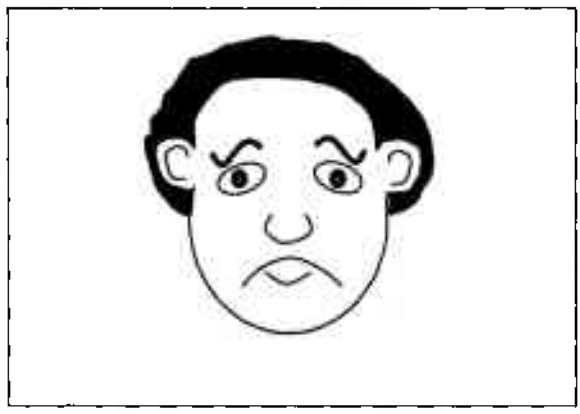

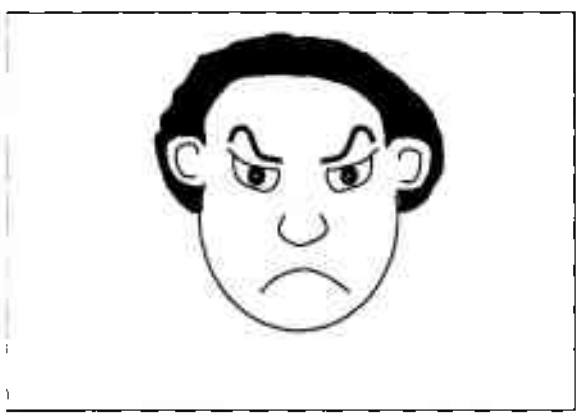

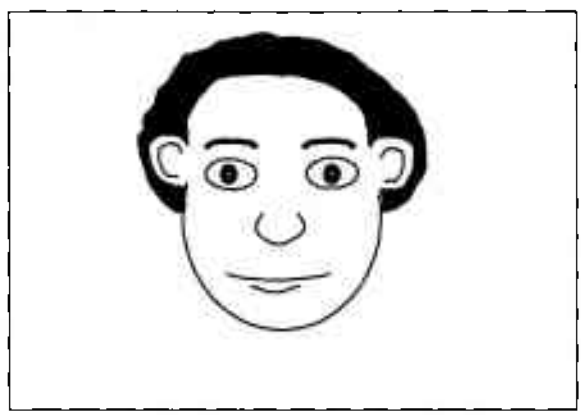

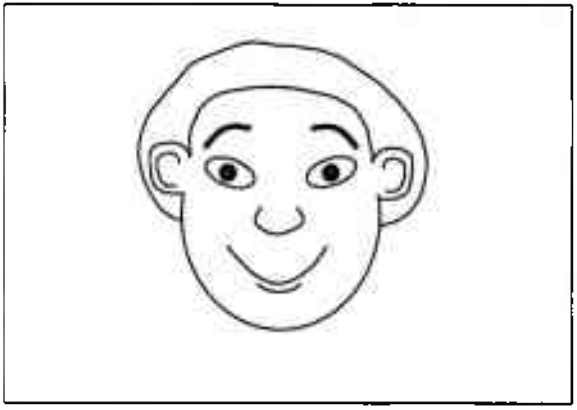

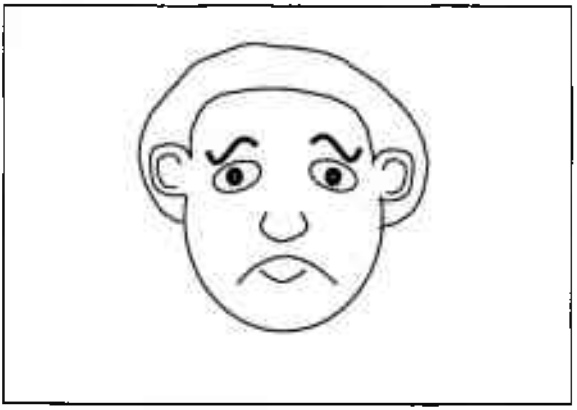

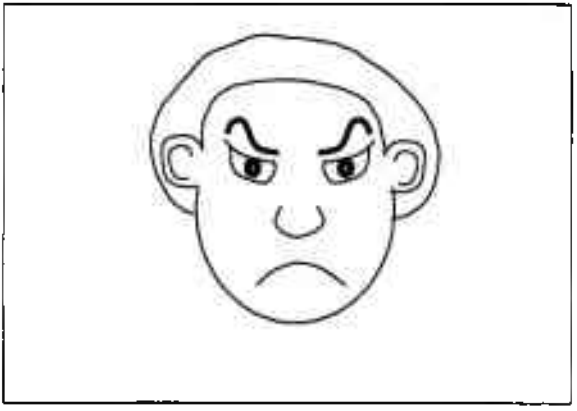

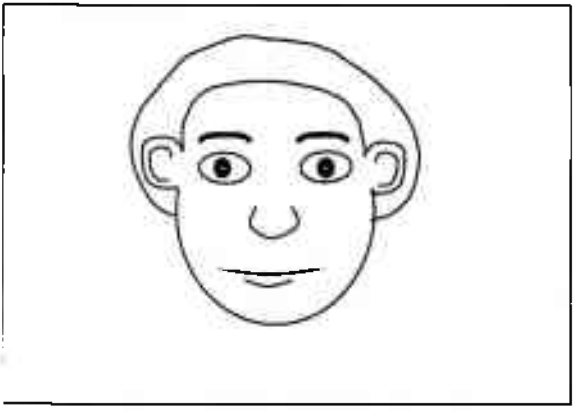

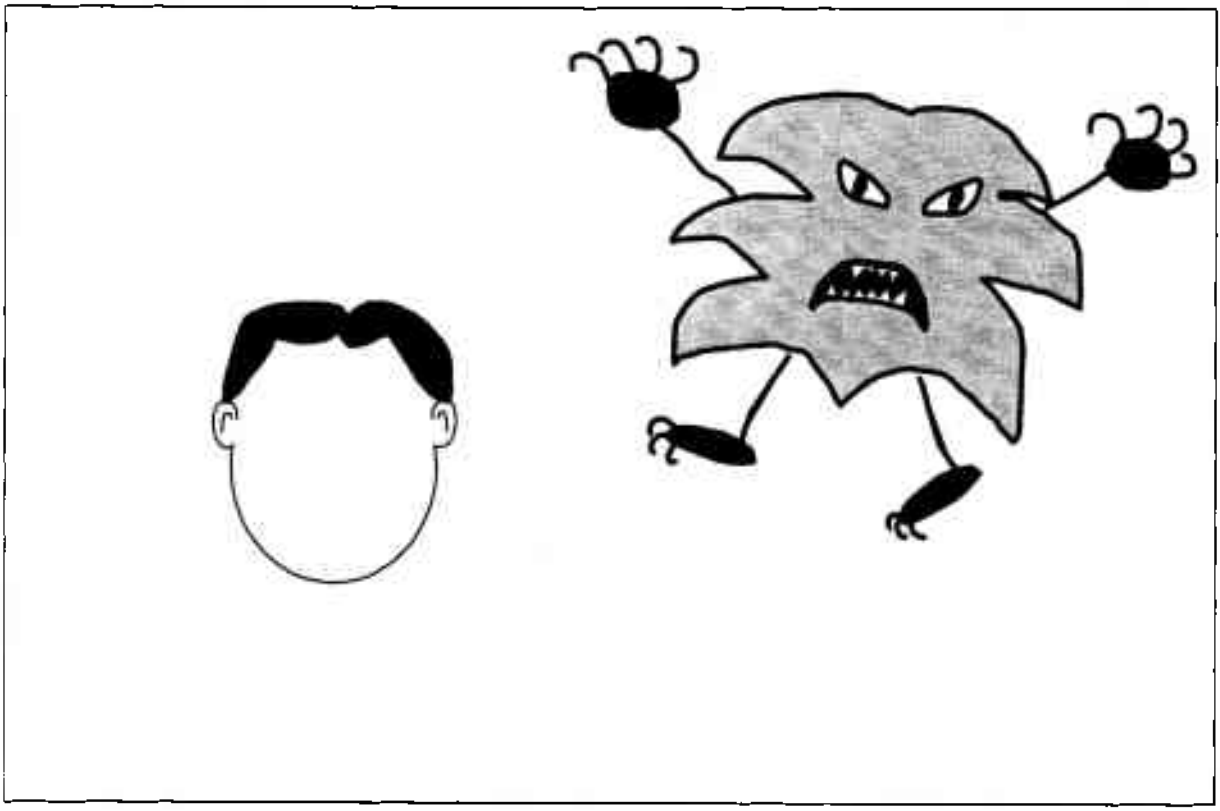

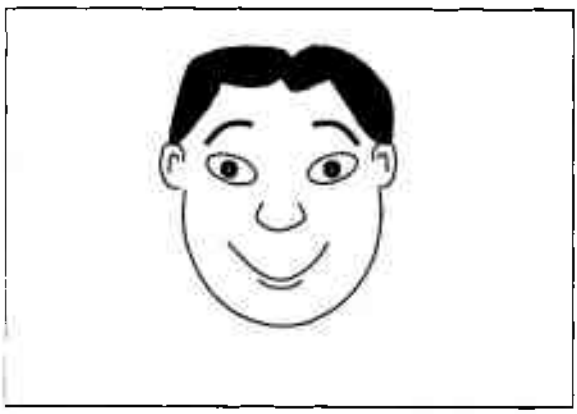

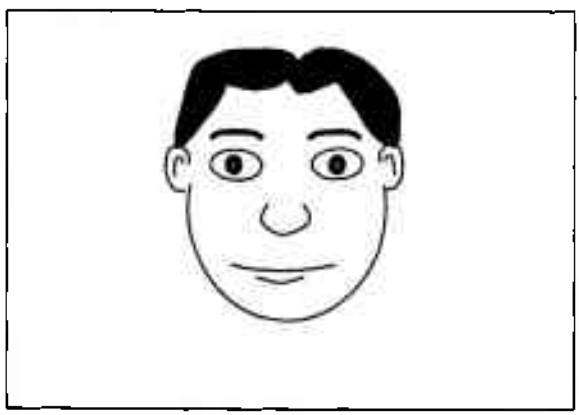

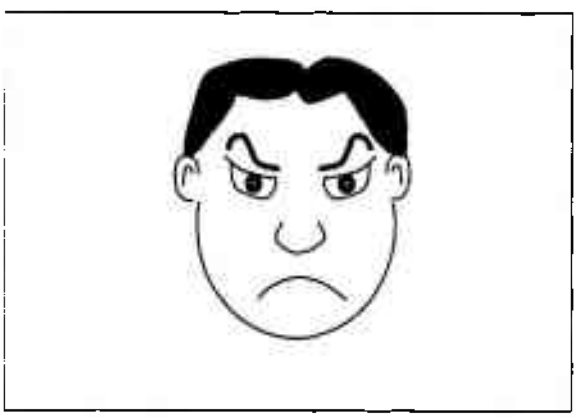

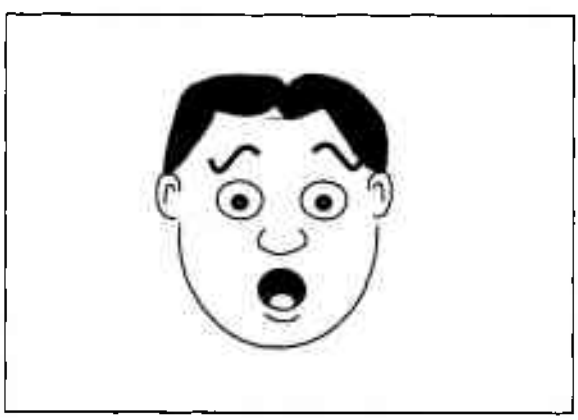

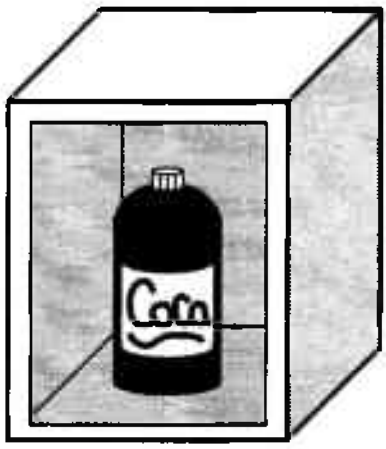
Coca