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The relationship between negative emotions and acute subjective and objective symptoms of childhood asthma

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ABSTRACT

Background. Children with asthma are vulnerable to negative emotions, but clinical observations and research suggest that negative emotions can also be precipitants of asthma attacks. Empirical data provided mixed results. The hypothesis was tested that negative emotions influence subjective rather than objective symptoms of asthma, breathlessness and airways obstruction, respectively.

Methods. Forty asthmatic children (aged 7 to 18 years) were randomly assigned to one of four experimental conditions: 1, viewing an emotional film of 10 min; 2, performing standardized physical exercise of modest intensity up to a heartbeat of 170 b/min; 3, combination of conditions, order conditions, 1+2; and 4, combination of conditions, order conditions 2+1. Lung function, breathlessness and state anxiety were measured pre-test and post-test. Respiration sounds were recorded continuously for assessment of emotional breathing patterns.

Results. The data and responses to exit questions, confirmed a successful induction of anxiety via increased state anxiety and respiratory rate. Viewing the emotional film did not by itself enhance airways obstruction or breathlessness. Airways obstruction and breathlessness increased significantly after exercise only. Significantly more breathlessness was reported when negative emotions preceded exercise. Breathlessness was statistically independent of lung function, severity of asthma, symptoms in the past 4 weeks, anxiety or age.

Conclusion. Negative emotions affect subjective, rather than objective symptoms of childhood asthma. It was suggested that children in a negative emotional state, uncertain about the condition of their airways, are inclined to interpret exercise-related general sensations (fatigue, heart pounding, sighing) in line with expectations as symptoms of airways obstruction. Consequently, they may report relatively high breathlessness, irrespective of actual objective symptoms of asthma.

INTRODUCTION

Childhood asthma is a chronic respiratory disorder, characterized by episodic, potentially life-threatening airways obstruction. Children who frequently experience breathlessness (dyspnoea) and those with a history of hospitalization for severe asthma often show evidence of negative emotions and psychosocial pathology (Friedman, 1984; Carswell, 1985; Yellowlees & Ruffin, 1989; Carson & Schauer, 1992). The stringent influence of asthma on lifestyle and quality of life are reflected in negative emotions and worry: anxiety, sadness, anger and eventually depression (Creer, 1983).

More intriguing is the proposition of reversed causality, i.e. negative emotions as the precipitants of asthma attacks. From the psychoanalytical point of view, repression of negative emotions was the core of an asthmatic state. Children were believed to inhibit hostility and crying, in order not to stray from a loved one's

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affection, causing respiratory distress and asthma. At first glance, this remarkable assumption found some support, as observations in a summercamp revealed that children with severe asthma showed less aggression than children with mild asthma (Straker & Tamerin, 1974). Inhibition of negative emotions by children, however, could be a consequence of a history of asthma, acquired after repeated exposure to emotional induction of asthma (Jurenec & Ullman, 1984; Florin *et al.* 1985).

There is substantial documentation of asthmatic exacerbations precipitated by emotional turmoil. This causal link is commonly reported by asthmatics or their relatives (Everaerd *et al.* 1990). Approximately 40% of 268 mothers in one study claimed that 5 minutes of crying caused asthmatic wheeze or cough in their child (Weinstein, 1984). Daily subjectively perceived stressors in the study by Goreczny *et al.* (1988) on adult asthmatics correlated significantly with self-reported asthmatic symptoms. In a more recent study, adult asthmatics from low socioeconomic status reported a high association between anxiety and depression and the onset of an asthmatic attack. In fact, 51% of these 57 subjects responded with 'frequently' or 'always' when asked how often asthma was triggered by being upset or anxious (Rumbak *et al.* 1993).

More convincing than self-reports of asthmatics concerning the association between negative emotions and asthmatic attacks would be experimental evidence for the influence of emotions on airways obstruction, reflected in a worsening of lung function. Most of these studies were conducted in the 1970s. Levenson (1979) observed consistent group effects of increased airways resistance in 29 mild asthmatic adults viewing emotional films. Hyland (1990) reported on a correlation between mood state and lung function (Peak Expiratory Flow) in six out of 10 adult asthmatics during assessment in the evening (without early morning assessment). Steptoe & Holmes (1985) reported an association between self-reported emotions and Peak Expiratory Flow rates as recorded in the home situation of asthmatic adults.

In one of the few studies involving asthmatic children, seven out of 13 children achieved a reduction in lung function during a film about a girl in a state of near fatal asthma (Weiss *et al.* 1970).

In recent reviews Isenberg *et al.* (1992) assumed that only one in five asthmatics would be vulnerable to emotion-induced airways obstruction (Lehrer *et al.* 1993). They emphasized that there were methodological problems and inconclusive empirical data of previous results.

In order to understand these differences in inter-experimental results, two relevant distinctions would be: (1) acute *versus* long-term physiological reactions to asthma-provoking stimuli; and (2) objective *versus* subjective symptoms of asthma.

With respect to the first distinction, Sterk & Bel (1989) emphasized the difference between excessive airways narrowing and airways hypersensitivity in asthma. Acute effects of negative emotions would be airways narrowing through airways smooth muscle contraction, for instance due to emotional breathing patterns (Bass & Gardner, 1985; Demeter & Cordasco, 1986; Lougheed *et al.* 1993). By mediation of a deterioration of immune responses, long-term effects of prolonged negative emotions or psychosocial pathology would be airways inflammation and/or increased hyper-responsiveness (Friedman & Booth-Kewley, 1987; Boyce *et al.* 1995). The distinction between acute and prolonged effects of negative emotions on airways obstruction may particularly explain different results between *in vivo versus in vitro* studies. However, the distinction would have methodological implications too, for instance by careful testing of the emotional state of subjects during intake in the experiment, as well as assessment of negative emotions and stressors in the last couple of weeks.

The second distinction, between objective and subjective symptoms of asthma, was in line with the aims of the current study. Although objective symptoms (airways obstruction) may generally enhance subjective symptoms (breathlessness) research demonstrated that breathlessness may occur in the absence of objective symptoms of asthma as in patients with agoraphobia and panic disorder (Wilson & Jones, 1991; Carr *et al.* 1992). One explanation may be that human beings are generally not accurate in the perception of airways obstruction, as evidenced by *in vivo* testing as well as signal detection experiments (Rietveld *et al.* 1996*a*). The sensory information associated with airways obstruction is often neither clear nor specific. Researchers agree that there is generally no linear relationship between degree of airways obstruction and breathlessness (Barnes, 1992; Jones, 1992; Rietveld, 1996). Consequently, it is likely that airways obstruction and breathlessness are differentially influenced by negative emotions, if at all. With respect to emotional influences on airways obstruction, eight mechanisms have been proposed, such as the cholinergic–adrenergic balance or hyperventilation (see Isenberg *et al*. 1992 for a recent review). With respect to emotional influences on breathlessness, the following four mechanisms can be distinguished.

1 Asthmatics in a negative emotional state are less accurate in symptom perception, facilitating biased perception (Hudgel *et al*. 1982).

2 Asthmatics in a negative emotional state would be more inclined to evaluate symptoms of asthma negatively (Costa & McCrae, 1987; Watson & Pennebaker, 1989).

3 It has been suggested that negative emotions and worry can be interpreted as symptoms of asthma, particularly irritability and anxiety (Dirks & Schraa, 1983). The emotional information is processed on a lower dimension, resulting in a labelling of emotional autonomic arousal as symptoms of asthma (Pennebaker, 1982).

4 A negative emotional state would trigger the processing of sensory information associated (but not strictly causally related) with asthma in terms of asthma symptoms, enhancing breathlessness (Rietveld, 1996). It is assumed that false attribution of general sensations to asthma would be most potent when: (*a*) asthmatics are uncertain about the condition of their airways; and (*b*) when the outcome of the false attributional process confirms subject's expectations about their airways (Rietveld *et al*. 1996*b*, 1997).

An uncertain situation could be created by having asthmatics perform a mild physical exercise task. Exercise-induced airways obstruction is a common phenomenon in asthma, caused by cooling of tissue during rapid breathing (Grossman & Wientjes, 1989). Former studies showed that children with asthma in an exercise setting were influenced into high breathlessness-reporting by false feedback of asthma-relevant information, respiration sounds and lung function values, respectively (Rietveld *et al*. 1996*b*, 1997).

The current study addressed the acute effects of negative emotions on airways obstruction as well as breathlessness. There were four experimental conditions, which made it possible to test the effects of negative emotions and exercise on airways obstruction and breathlessness, and particularly to test the hypothesis that negative emotions trigger the interpretation of general bodily sensations after exercise as the symptoms of asthma, enhancing breathlessness.

METHOD

Subjects

A sample of 40 children with a doctor's diagnosis of asthma participated, aged 7 to 18 years (mean = 12·2, S.D. = 3·5). Former studies with a similar test design showed consistently that normal control children were not influenced towards breathlessness-reporting (Rietveld, 1996). Hence, a control group was not included in this study.

The asthmatic children enrolled via referral from general physicians in Amsterdam, The Netherlands, and from advertisements in a local newspaper. Intake criteria included: a prior doctor's diagnosis of asthma; and prescribed medication fitting classification of asthma severity according to the criteria of the British Thoracic Society (1993). The study was conducted according to the ethical norms of the Dutch Society of Psychology. Children and parents were correctly and honestly informed about the experimental tasks. The children were informed that they could leave the study whenever they wanted to, without any consequences. These children did not receive any treatment at the university and came to the institution specially for the experiment. The parents gave informed consent and the children agreed to participate and were financially rewarded.

The severity of asthma was classified from 1–5 on the basis of prescribed medication (British Thoracic Society, 1993). There were eight children with a diagnosis of severe asthma, treated with oral prednisolone or large doses (800 μg) of inhaled corticosteroids, and long-acting and short-acting bronchodilators. Five children were diagnosed with moderate–severe asthma and were treated with inhaled corticosteroids (400–800 μg), and long-acting and short-acting bronchodilators. There were 10 children with moderate asthma and they used small doses of inhaled corticosteroids and bronchodilators. Eleven children were diagnosed with moderate–mild asthma; treated with ipratropiumbromide, sodium cromogliquate and bronchodilators. Another six children had mild asthma and they used bronchodilators when needed only. In order to prevent children from being confident that they would not have symptoms of asthma during the experiment, they were instructed not to use bronchodilator medication on the morning of testing.

The experimental design comprised four experimental conditions and the children were randomly assigned to one of them: condition 1, emotional film; condition 2, physical exercise task; condition 3 combination of conditions, order 1+2; or (4) combination of conditions, order 2+1. The different order of negative emotions and physical exercise in conditions 3 and 4 was meant to test the differential effect of negative emotions on the interpretation of general sensations. Note that the children conducted only one experimental condition on the basis of random assignment.

Measures

Assessment of lung function

Airways obstruction was measured pre-test and post-test by lung function testing with a pneumotachograph (Pneumoscreen II, Erich Jaeger, Germany) and was expressed as Forced Expiratory Volume in 1 second (FEV_1). The tests were all performed by the same lung function assistant. The children breathed through a mouthpiece while seated and wearing a noseclip. The highest of three FEV_1 values was used for analysis. The absolute FEV_1 and the percentage FEV_1 predicted for a child without asthma of similar sex, age, weight and height were used for analysis.

Assessment of breathlessness

Breathlessness was defined and explained to the children as laboured breathing, shortness of breath, tightness of the chest or wheeziness (Rietveld, 1996). The degree of breathlessness was measured pre-test and post-test with a self-report Likert-type scale. This was a horizontal line with ten scale points, ranging from 0 (no breathlessness) to 9 (severe breathlessness).

Control measures

There were three variables measured to check the effect of the induction of negative emotions: state anxiety; emotional breathing pattern (respiratory rate); and self-reported emotional involvement during the exit-interview.

Assessment of state anxiety

State anxiety was measured pre-test and post-test with a Dutch version of the subscale 'state anxiety' of the Spielberger Trait and State Anxiety Inventory (Spielberger *et al*. 1973; Bakker *et al*. 1989; Colland, 1993). The scale consists of 20 statements and the children had to mark one of three response options 'yes', 'sometimes' or 'never', corresponding with scores 1, 2 or 3. The total score ranged from 20–60 points. The children were instructed that this form addressed the current situation, as compared to the 'trait anxiety' subscale (see below). They were also instructed not to skip any items.

Assessment of emotional breathing patterns (respiratory rate)

It was expected that the induction of emotions would be reflected in an increase of respiratory rate (RR) (Boiten, 1993). This would imply that an increase of RR could be used to check the effect of the induction of negative emotions. To this end, the RR was counted by one rater during each minute of sound recording and expressed in ten values, corresponding with 1 min baseline recording and 9 min of experimental recording during the film. Tracheal sounds were recorded with the system of Continuous Respiratory Telemetry (Emco Electronics, Assendelft, The Netherlands). The hardware consisted of microphone, transmitter, receiver and recording equipment (Hitachi VT-F8290). The electret microphone (range 20–25000 Hz within 3 db) was fixed in a polyester cover. This was placed over the supra-sternal notch with a double-sided adhesive anti-allergic ring (ARBO T08). The transmitter and rechargeable battery were carried on a waistbelt.

Exit interview questions

During the exit procedure, the children marked a scale with only two response options ('yes'/'no') asking whether they had been emotionally involved during the film. Their response was followed by questions about the nature of the emotion, anxiety or sadness (Rietveld & Colland, 1997).

Co-measures

Assessment of asthma severity

See under heading 'subjects'.

Assessment of symptoms in the past 4 weeks

It was assumed that children with a high level of perceived symptoms over the past period, reflecting a subjective sense of handicap, would be more inclined to be emotionally involved by the film. Hence, in order to assess how children evaluated their asthma (retrospective recall), the number of days with symptoms of asthma in the 4 weeks preceding testing were measured via a structured interview with child and parent(s). This resulted in a score, ranging from 0 (no symptoms) to 56 (continuous symptoms of asthma during each of the preceding 28 days). The symptoms were defined as 'severe sense of breathlessness' and/or a worsening of Peak Expiratory Flow (measured with a mini-peak-flowmeter). When these symptoms were observed twice a day or during a whole day, a score of two was given.

Assessment of trait anxiety

Trait anxiety was measured during pretest by means of a Dutch version of the subscale 'trait anxiety' of the Spielberger Trait and State Anxiety Inventory. See under heading 'Assessment of state anxiety'. The children were instructed that the form addressed their cognitions and feelings in general, as compared to the 'state anxiety' subscale.

Experimental conditions

Condition 1 Emotional film

The children were shown a film meant to induce negative emotions, lasting nearly 10 min. The film was a compilation of emotional scenes from a longer children's film. This presented the story of a (non-asthmatic) boy, aged approximately 10 years, whose friend dies, then kills his cruel mother and undergoes imprisonment. In addition to the normal sound track, there were background breath sounds audible throughout the film, changing into asthmatic wheezes during emotional scenes. Wheezes are secondary asthmatic respiration sounds, such as high-pitched wheeze or solitary rhonchi (Rietveld *et al.* 1995). The wheezing sounds were added after pilot testing with different subject groups and were to give the film more relevance to asthmatic children (Rietveld & Colland, 1997).

Condition 2 Physical exercise task

The children performed standardized physical exercise in order to induce general sensations, such as fatigue, heart pounding and sighing. Although physical exercise may induce actual symptoms of asthma, the current task was mild only and conducted under indoors, optimal circumstances with respect to temperature and humidity (Killian & Campbell, 1983; Anderson, 1985). It was expected that lung function would only be reduced modestly or not at all, but that all children, after exercise, would be uncertain about the condition of their airways. A high majority of asthmatic children has experience with exercise-induced asthma and cognitive elaboration on sensory information after exercise can be expected. After pre-test assessments, sound recording equipment and a heart beat control device were placed on each child. Tracheal sound recording commenced (with 1 min baseline recording) and continued until after post-test assessments. The task consisted of free running and the children could choose their own speed of running.[1] They ran through a broad and empty corridor in the building until a heart beat rhythm of 170 b/min was signalled by the heart beat control device, strapped around the chest of each child (Polar Edge, Semex Medische Techniek, Nieuwegein, The Netherlands). The building was air-conditioned and the temperature at 1·5 m above ground level ranged from 20–22 °C and the humidity was between 60–64%. A technician listened on-line to the respiration sounds of each child and to background sound though a headphone in order to check running progress and heart beat control. The children were instructed and encouraged to continue running until told to stop. After exercise, they remained seated for 5 min and they were requested to restrain from moving and talking. Children with a significant degree of airways obstruction used bronchodilator medication in order to normalize lung function. After

[1] Former studies showed that subjects who participate freely in the experiment quite easily reach the target of 170 b/m (Rietveld, 1996).

10 min, the effect of this medication was tested, but the data were not used in the analysis.

Condition 3 Combination of condition 1 and condition 2; order 1+2

Children participated in condition 1 and, without post-test assessment of lung function, breathlessness and state anxiety, conducted physical exercise in condition 2. This enabled testing the effect of negative emotions on the interpretation of exercise-induced sensations during post-test assessment of breathlessness.

Condition 4 Combination of condition 1 and condition 2; order 2+1

Children participated in condition 2 and, without post-test assessment of lung function, breathlessness and state anxiety, were exposed to the emotional film of condition 1. This enabled testing of the effect of physical exercise followed by negative emotions on breathlessness-reporting.

Data analysis

The first step was verifying the effect of the induction of negative emotions. The increase of state anxiety after the film ('testing' effect) and also the difference between conditions ('condition' effect) was tested in a multivariate analysis of variance for repeated measures (MANOVA). The differences between post-test values between conditions were tested with Tukey's Honestly Significance Test. The differences between pre-test and post-test values were tested with paired t tests, separately for different conditions. The α level for all statistics was set at $P < 0{\cdot}05$.

The increase of RR during the film was tested by t testing the difference between the mean RR at 1 min baseline *versus* the emotional height of the film (minutes $7+8$). Then, the exit-interview data were computed.

The second step consisted of testing the effect of 'condition' and 'testing' (pre-test/post-test) on lung function (percentage $FEV_{1\,predicted}$) with MANOVA.

The third step was testing the effect of 'condition' and 'testing' (pre-test/post-test) on breathlessness with MANOVA.

Finally, correlations (PMCC) were computed between the various measures (percentage of lung function predicted; breathlessness; state anxiety; RR; asthma severity; symptoms of asthma in the past 4 weeks; trait anxiety).

RESULTS

State anxiety

State anxiety increased significantly during the experiment. The MANOVA showed a significant main effect of 'testing' (pre-test/post-test) on state anxiety ($F(1,36) = 46{\cdot}23$, $P < 0{\cdot}001$). There was no significant difference in state anxiety between conditions. The effect of 'condition' on state anxiety was not significant ($F(3,36) = 1{\cdot}06$, $P = 0{\cdot}378$). The interaction effect between 'condition' and 'testing' was significant ($F(3,36) = 3{\cdot}33$, $P = 0{\cdot}030$). Paired t tests showed significant differences in state anxiety between pre-test and post-test in conditions 1, 3 and 4 ($P < 0{\cdot}05$) (Table 1). Tukey's Honestly Significance Test showed no significant differences between conditions ($P < 0{\cdot}05$).

Mean RR in conditions with induction of

Table 1. *Means and standard deviations of pre-test and post-test percentage FEV_1 predicted* (% FEV_1), *breathlessness* (*B*), *symptoms in the past 4 weeks* (*Symptoms*)*, *state anxiety* (*State A*), *trait anxiety* (*Trait A*)*, *in condition 1/4*

	Pre-test		Post-test	
	Mean	S.D.	Mean	S.D.
Condition 1 ($N = 10$)				
% FEV_1	96·70	6·63	96·00	5·62
B	0·60	0·52	0·90	0·74
Symptoms	2·90	3·03	—	—
State A	40·80	6·00	48·20	2·62
Trait A	32·40	6·70	—	—
Condition 2 ($N = 10$)				
% FEV_1	96·80	5·07	91·60	10·44
B	0·60	0·70	2·90	1·52
Symptoms	13·90	17·98	—	—
State A	43·20	4·47	45·90	5·28
Trait A	31·00	5·06	—	—
Condition 3 ($N = 10$)				
% FEV_1	92·00	7·13	87·00	10·07
B	0·70	0·67	4·80	1·87
Symptoms	2·70	1·57	—	—
State A	45·50	3·06	48·10	2·33
Trait A	29·30	3·56	—	—
Condition 4 ($N = 10$)				
% FEV_1	95·10	9·65	90·30	12·49
B	1·00	0·82	3·90	1·66
Symptoms	2·90	3·57	—	—
State A	41·70	5·79	45·70	5·03
Trait A	31·20	4·69	—	—

* Assessed during pre-test period only.

Table 2. *Correlation matrix of variables; pre-test percentage* FEV_1 *predicted* (1 % *F*), *post-test percentage* FEV_1 *predicted* (2 % *F*), *pre-test breathlessness* (1*B*), *post-test breathlessness* (2*B*), *severity of asthma* (*Se*), *symptoms in the past* 4 *weeks* (*Sy*), *pre-test state anxiety* (1*SA*), *post-test state anxiety* (2*SA*), *and trait anxiety* (*TA*), $N = 40$

	1 % F	2 % F	1B	2B	Se	Sy	1SA	2SA	TA
1 %F		0·83**	−0·18	−0·17	−0·22	−0·09	−0·30	−0·21	0·12
2 %F	—		−0·15	−0·28	−0·14	−0·13	−0·35	−0·19	0·10
1B	—	—		0·30	0·34	0·08	−0·19	−0·17	0·08
2B	—	—	—		0·09	−0·07	0·10	−0·22	0·00
Se	—	—	—	—		0·49**	−0·39	0·00	0·18
Sy	—	—	—	—	—		0·09	0·00	0·22
1SA	—	—	—	—	—	—		0·60**	0·16
2SA	—	—	—	—	—	—	—		0·03
TA	—	—	—	—	—	—	—	—	

** $P < 0·01$.

negative emotions increased from 16·7 to 18·6 and this difference was significant ($t(29) = 4·03$, $P = 0·022$).

There were 26 children (87 %) who considered the film to be emotional; 16 children mentioned anxiety and 18 sadness. All by four children achieved the exercise criterion of 170 b/min. The data for these four children were not excluded from analysis because the aim of the exercise task was induction of general sensations and uncertainty about the condition of the airways, rather than severe airways obstruction.

Lung function (FEV_1)

Lung function (FEV_1) decreased significantly in conditions with physical exercise, but not in condition 1 with negative emotions only. The MANOVA showed a significant main effect of 'testing' (pre-test/post-test) on FEV_1 ($F(1, 36) = 19·71$, $P < 0·001$). There was no significant main effect of 'condition' on FEV_1 ($F(3, 36) = 1·21$, $P = 0·32$). The interaction effect between 'testing' and 'condition' was not significant ($F(3, 36) = 1·45$, $P = 0·25$). Paired *t* tests showed significant differences between pre-test and post-test in conditions 2, 3 and 4 ($P < 0·05$). Tukey's Honestly Significance Test showed significant differences between conditions 1/2, 1/3 and 1/4 ($P < 0·05$).

Breathlessness

Breathlessness increased significantly in conditions with physical exercise, but not in condition 1 with only negative emotions. The highest breathlessness was recorded in condition 3 with negative emotions preceding physical exercise. The MANOVA showed a significant main effect of 'testing' (pre-test/post-test) on breathlessness ($F(1, 36) = 109·14$, $P < 0·001$). There was a significant main effect of 'condition' on breathlessness ($F(3, 36) = 9·28$, $P < 0·001$). The interaction effect between 'testing' and 'condition' was also significant ($F(3, 36) = 11·94$, $P < 0·001$). The paired *t* tests showed significant differences between pre-test and post-test in conditions 2, 3 and 4 ($P < 0·05$). Tukey's Honestly Significance Test showed significant differences between conditions 1/2, 1/3, 1/4 and 2/3 ($P < 0·05$).

Correlations between measures

Pre-test and post-test FEV_1 and state anxiety correlated significantly, and so did asthma severity with the number of symptoms of asthma in the past 4 weeks. Breathlessness did not significantly correlate with lung function; severity of asthma; symptoms in the last 4 weeks; state anxiety; trait anxiety; RR or age (Table 2).

DISCUSSION

Negative emotions and exercise-related sensations were induced in four experimental conditions. Control variables confirmed the successful induction of negative emotions (anxiety). The results provided support for the hypothesis that asthmatics in a negative mood tend to interpret general, exercise-induced sensations as symptoms of asthma, reflected in relatively high breathlessness-reporting.

Viewing an emotional film did not by itself influence (enhance) airways obstruction or breathlessness (condition 1). Airways obstruc-

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tion and breathlessness both increased significantly after physical exercise only (conditions 2, 3, 4), with the highest breathlessness in condition 3. Neither lung function nor breathlessness correlated significantly with any of the other variables. In particular, the lack of a correlation between state anxiety and breathlessness was noteworthy, and refuted two alternative explanations for the major current result: state anxiety was not a major component of breathlessness, and the false interpretation of emotional arousal as breathlessness could only modestly explain variance in breathlessness (Pennebaker, 1982; Dirks & Schraa, 1983; Wilson & Jones, 1991). When considering the heterogenous sample with respect to age and asthma severity, it is important to mention that these variables did not correlate with either breathlessness or anxiety (Rietveld, 1996); compare Spittle & Sears (1984) for similar results with adults.

It is suggested that the mechanism of asthma-congruent interpretation of sensations would be particularly potent in a situation with asthmatics being uncertain about the condition of their airways. The mechanism would possibly only be potent when false interpretation was in line with expectations, such as the possibility of exercise-induced airways obstruction. There were several sensations, loosely associated with asthma, that could have been interpreted in terms of asthma, such as fatigue, heart pounding, hyperventilation, sighing and possibly worry and anxiety.

Contrasting with the current research, some previous studies achieved actual emotion-induced airways obstruction. Asthmatic children in the study by Tal & Miklich (1976) had a worsening of lung function after vividly remembering emotional events, but the patterns were individually-specific and there was no general causal relationship between lung function and any particular emotion (Vazquez & Buceta, 1993). The current induction of emotion primarily comprised anxiety and (according to exit-interviewing) sadness – not anger, although the latter might have been more influential with respect to airways obstruction (Straker & Tamerin, 1974). However, sadness has also been reported to be a trigger of exacerbations of asthma (Levitan, 1985). Nevertheless, it is most likely that the film induced several emotions simultaneously, some perhaps diffuse to the children themselves.

The current test results could explain the mixed and inconsistent results in previous research by stressing the distinction between objective and subjective symptoms of asthma.

With respect to the clinical relevance of the current results, it can be concluded that negative emotions can influence the interpretation of general sensations towards symptoms of asthma, irrespective of actual airways obstruction. This may provide one explanation for the common phenomenon of asthmatics complaining about asthma after being emotional. Weinstein (1984) noted that parental discipline was the major cause for negative emotions in children and that many parents altered discipline in order to prevent emotion-induced asthma in their children. Because a majority of asthmatics is incapable of accurately perceiving asthma symptoms, psychological and particularly emotional factors can dominate the process of symptom perception towards biased interpretation of sensations. In children, objective measures, such as assessment of Peak Expiratory Flow with a mini-peakflowmeter would be warranted. The current results are consistent with the symptom perception theory, emphasizing the influence of psychological and situation factors in the process of interpreting and evaluating asthma symptoms (Pennebaker, 1982).

One implication for future research in asthma symptomatology would be the necessity to differentiate subjective and objective symptoms of asthma. This distinction is particularly important because the magnitude of subjective symptoms generally provides the basis for illness behaviour and medical consumption. It is the emotional factor that may even widen the gap between the subjective and objective symptoms of asthma.

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