The influence of distraction on pain and anxiety during venipuncture in children aged between 8 and 11 years

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Objective: As in adults, psychological factors such as stress, anxiety and the impact of the medical procedure may influence the experience of procedure pain in children. In this study we focused on pain during venipuncture in children. Anxiety seems to be an important predictor of the pain experience. Cognitive processes of anxiety, such as catastrophising and avoidance behaviour, can be influenced in various ways. One way of reducing pain and anxiety is distraction.

Methods: A randomised and controlled experimental design study was conducted in a research population of 20 ambulatory patients aged between 8 and 11 years old, who were referred to the specialised department for child venipuncture at the University Hospital of Maastricht. Our distraction intervention was completing a find-the-hidden-items puzzle. Control patients did not receive any distraction.

Results: Distraction did not reduce pain and anxiety in the experimental group as compared with the control group. Children with high anxiety reported more pain than children with low anxiety. The results for catastrophising showed the same trend as the low- and high-anxiety groups, but were not statistically significant. Distraction lowers anxiety in children who do not watch the venipuncture, but not in children who prefer to watch the venipuncture.

Conclusion: Distraction can be an effective intervention to decrease pain and anxiety, when controlling for anxiety levels and eye orientation. *(Netherlands Journal of Psychology, 63,* 21-28.)

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Different theories have been advanced to explain the physiological and psychological mechanism concerning the influence of distraction on pain. In adults, studies have shown that regardless of anxiety ratings, distracting attention from a painful stimulus resulted in lower pain measurements than when attention was directed to the painful stimulus. (Arntz, Dreesen, & Merckelbach, 1991; Arntz, Dreesen, De Jong, 1994; Arntz, De Jong, 1993) The idea is that pain-related fear would direct attention towards the

pain stimulus and therefore increase subjective pain. The presence of other stimuli, however, would decrease pain because attention is distracted from the pain stimulus. McCaul and Malott (1984) hypothesise that the manipulation of attention is effective because distraction techniques use an amount of the capacity of attention that would normally be used for the perception of pain (McCaul & Malott, 1984). Furthermore, in a more recent study they found that distraction works especially when the distraction task evokes positive emotions (McCaul, Monson, & Maki, 1992). These tasks do not only reduce pain, but are also effective in reducing anxiety. Within these distraction tasks a distinction can be made between tasks which demand controlled attention (through serial processing) and use a substantial amount of attention capacity, and tasks which demand only automatic attention (through parallel processing) and only use a small amount of attention capacity (Lautenbacher, Pauli, Zaudig, & Birbaumer, 1998). In the opinion of McCaul & Malott (1984), the perception of pain can be seen as a controlled process. Therefore, distraction tasks which demand sufficient controlled attention are preferred because they can compete with the attention demanded by pain.

An intriguing question is whether the pain mechanisms for adults can be applied to children. As in adults, the importance of anxiety is underlined in many studies. A study by Goodenough, Kampel, Champion, Laubreaux, Nicholas, Ziegler and McInerney (1997) shows that anxiety is one of the most important predictors of experienced pain in children. The more anxiety they feel, the more pain they will experience. Research also shows that, as in adults, children find pain an unpleasant sensory and emotional experience, but the character of the studies performed in children is different from those performed in adults. Research in adults is mostly experimental, but in children most of the research has focused on the implementation of anxiety- and pain-reducing techniques. Studies in children used different distraction techniques, such as hypnosis, preparation and relaxation, to reduce the pain and anxiety in children. Sometimes these techniques were used as single interventions, but in most cases they were integrated in a package of cognitive-behavioural interventions. These treatment methods usually consist of breathing exercises, imagery, filmed modelling, positive confirmation and behaviour therapy, with breathing exercises and imagery considered to be a distraction technique. In breathing exercises the child is taught to concentrate on breathing (toys or whistles may be used here) instead of the pain. When using imagery, the child is taught to think about a favourite subject (such as a comic hero or favourite place) and then to think about this during the pain period. Other methods that have been used in studies are counting, games, books or other toys. Distraction as part of cognitive behaviour therapy in children has proven to be effective in a number of studies (for an overview, see Powers, 1999).

When we look at studies that use distraction as the single intervention, we also find evidence of its effectiveness. In 1992, Broome, Lillis, Wilson-McGahee and Bates performed a study on the use of distraction in children aged from 3 to 15 years during painful medical procedures. They found a significant reduction in the subjective pain experience after using distraction by means of imagery, relaxation and breathing techniques (Broome, Lillis, Wilson-McGahee, & Bates, 1992). In the study by Lal, McClelland, Phillips, Taub and Beattie (2001) similar results were found. In their study, 27 children were distracted during venipuncture. The children were divided into two groups, namely (1) EMLA (local anaesthetic cream containing lidocaine and prilocaine) + distraction and (2) placebo + distraction. Significant pain reductions were measured in both groups which, according to the investigators, could be attributed to the distraction technique consisting of slowly counting out loud and breathing with the help of a small windmill. However, questions could be raised about the design of this study and how the groups were formed (Lal, McClelland, Phillips, Taub, & Beattie, 2001). The study by Vessey, Carlson and McGill (1994) also supports the hypothesis that distraction is effective in reducing pain in children. In their study they used a kaleidoscope to distract children aged between 3 and 12 years during venipuncture. They also found a significant reduction in pain by using distraction (Vessey, Carlson, & McGill, 1994). There is only one study where distraction was not found to be effective, namely the study by Arts, Abu-Saad, Champion, Crawford, Fisher, Juniper and Ziegler (1993). In their comparison with EMLA, a placebo and distraction by music, the use of EMLA was the best intervention. Distraction by music was somewhat more effective than placebo, but inferior to the effect of EMLA.

Taking into consideration the results of previous research, some questions still remain on how children experience pain and which mechanisms and factors are of influence. First, it is unknown if distraction is as effective in children who catastrophise about pain as compared with children who do not. Pain catastrophising is known to be associated with an increased attention towards pain and difficulties of distracting attention from pain. Furthermore, people with catastrophising thoughts about pain experience experimental pain stimuli as more intense than people who do not have those thoughts and are also more anxious when they expect pain (Mascagni, Bijttebier, Crombez, & Vlaeyen, 2001). An important function of fear is that it automatically prepares the person for action. This implies that

pain catastrophisers automatically shift their attention toward the stimulus that demands action. In a context where this urge to act cannot easily be converted into escape or avoidance behaviour, there is an automatic attentional shift to the object of fear and intentional forms of attention are needed to suppress the urge to act (Crombez, Vansteenwegen, Baeyens, & Eccleston, 1998). These findings are supported by recent research by Piira, Taplin, Goodenough and von Baeyer (2002). In their study on cognitive behavioural predictors of pain tolerance in children, they found that children with catastrophising thoughts had a lower pain threshold than children with no catastrophising thoughts. According to Crombez, Vansteenwegen, Baeyens and Eccleston (1998), a distraction task for high-catastrophising children should be more demanding than the automatic shift of attention towards the object of fear. Therefore we hypothesise that low-catastrophising children are easier to distract as compared with high-catastrophising children as they are not confronted with this automatic shift of attention. The same can be said for low-anxiety children. Pain-related anxiety will direct attention towards the pain (Arntz, Dreesen, & Merckelbach, 1991; Arntz, Dreesen, De Jong, 1994; Arntz, de Jong, 1993). Therefore the more anxiety children experience, the more the attention will be directed towards the pain. We can assume that the distraction task has to be strong enough to change the direction of attention. This direction could possibly be easier to change in low-anxiety children than in high-anxiety children.

Second, it is unknown if children who intentionally direct their attention away from the procedure (non-lookers) are easier to distract then children who do look (lookers). Research shows that looking away is one of the most common behavioural coping efforts that children use to maintain control. Distraction may enhance their effort (Hodgins & Lander, 1997).

In this study, we choose venipuncture as the medical procedure to test our hypotheses. We hypothesise that (1) distraction during venipuncture will decrease experienced pain and anxiety, (2) distraction will be most effective for low-anxiety and low-catastrophising children and (3) children who habitually look towards the venipuncture (lookers) are more difficult to distract than children who do not (non-lookers) and therefore experience less benefit from the distraction procedure.

Methods

Population

Twenty ambulatory patients between the age of 8 and 11 years old, who were referred by their physician to a special child venipuncture unit at the University Hospital Maastricht, participated in this study.

At this age, children normally make a shift from concrete to abstract reasoning about pain. The child has sufficient understanding about the cause and effect of the treatment and is able to see venipuncture as part of the treatment. Age has also proven to be a good predictor of variance in pain-related scores, with young children reporting more pain than older children (Arts et al., 1993). These findings are, however, greatly dependant on the measuring instruments used. Studies that make use of both self-report measures and observation methods frequently find no age differences. The same applies to sex differences; some studies show no differences between the sexes, while other studies have found that girls report more pain than boys (Carr, Lemanek, & Armstrong, 1998).

Children who have a cognitive impairment or who are colour-blind were not included. The selection of children was done by the researcher or the attending physician.

Children and parents were informed through written and oral information and the parents also signed an informed consent form. An independent physician was appointed and fully informed about the study. Permission for the study was granted by the Medical Ethics Committee of the University Hospital Maastricht and the University of Maastricht.

Design

The hypotheses were tested in a randomised controlled experiment. We distinguish two groups. One group received the normal procedure without the distraction task and the other group received the additional distraction task.

The distraction task consisted of a puzzle in which children have to detect a hidden figure. The book, containing 13 'find-the-hidden-items puzzles', called 'Where is Wally?' was used. Each puzzle is 31.5 centimetres by 50.5 centimetres. The puzzles are very lively with lots of colours. We used the second puzzle from this book in which the children had to search for the character Wally and other items. The child was instructed to find as many items as possible. A pilot study with 34 children aged between 8 and 11 years old was conducted to decide which puzzle was most suitable.

Instruments

Pain and anxiety measurements

In this study we used a modified version of the VAS by Abu-Saad (1984), which consists of visual, numeral and verbal extremities. A visual analogue scale is a vertical or horizontal line with verbal or numerical extremities, which repre

sents a continuum from 'no pain' to 'extremely painful'. The child is instructed to mark the line where it represents his or her pain experience. The score is measured in centimetres or millimetres (Price, McGrath, Raffii, & Buckingham, 1983). Children from the age of 5 are able to use the VAS in a reliable and valid way (McGrath, 1987; McGrath & de Veber, 1986).

Catastrophising

Pain catastrophising of the parents was assessed by the Pain Catastrophising Scale (PCS) (Sullivan, Bishop, & Pivik, 1995). The PCS consists of 13 items, each rated on a five-point scale from 0 ('not at all') to 4 ('always'). Research on the Dutch version shows that it has the same factor structure as the English version (Damme, Crombez, Bijttebier, Goubert, & Houdenhove, 2002).

The PCS for children is based on the adult version. However, some changes were made in the formulation of a few items. The Dutch version of the PCS for children is to be considered a reliable instrument, suitable for individual assessment (α-coefficient is 0.87) (Mascagni, Bijttebier, Crombez, & Vlaeyen, 2001). In this study we used the sum scores of the scales for adults and children.

Procedure

First the baseline pain of the children was measured by means of a VAS scale. Next the following factors were assessed: (1) the expected pain before venipuncture (VAS2PAIN), (2) the expected anxiety before venipuncture (VAS2ANXIETY) and (3) both the adult and child completed the Pain Catastrophising Scale (PCS/PCS-C).

After these first measurements the children were randomised over two groups following the randomisation procedure performed by a person who was not involved in the study. The nurse was instructed not to use any kind of distraction with children who were assigned to the control condition. Children in the distraction group were asked to search for as many items of the 'Where is Wally' puzzle as possible, starting from the moment the nurse began disinfecting their arm for the venipuncture. Children were asked to keep searching for items until the venipuncture was over and the nurse had put a sticking plaster on the arm. Parents were instructed to keep the puzzle visible for the children and specifically asked not to help in searching for items.

During the distraction task the researcher observed whether the child looked at the venipuncture. A child who looked at the venipuncture one or more times was considered a 'looker'.

After the venipuncture the children again completed four VASs assessing the experienced pain (VAS3PAIN), the experienced anxiety (VAS3ANXIETY) and the expected pain and anxiety for an imaginary venipuncture in the future (VAS4PAIN and VAS4ANXIETY). For the statistical analyses we used the Mann-Whitney U test, because of the relatively small sample size.

Results

The effects of distraction on pain and anxiety

Table 1 shows the results of the effects of distraction on pain and anxiety. The independent variable was the condition (distraction versus no distraction). The dependent variables were pain experience and anxiety, measured by VAS scales. We did not find differences between the conditions with regard to pain or anxiety scores immediately after the venipuncture (VAS3PAIN,

Table 1 Mean pain and anxiety scores for the two groups

Measurement	*Intervention (experimental group) M (SD)*	*No intervention (control group) M (SD)*	*P (two-sided)*
Baseline	1.17 (1.36)	0.98 (1.46)	0.879
VAS2PAIN	3.15 (2.13)	2.47 (1.85)	0.545
VAS3PAIN	2.84 (2.22)	2.77 (2.53)	0.544
VAS4PAIN	3.67 (2.68)	2.14 (1.55)	0.240
VAS2ANXIETY	3.05 (2.76)	2.54 (2.89)	0.623
VAS3ANXIETY	2.73 (3.04)	2.22 (2.80)	0.820
VAS4ANXIETY	2.17 (2.06)	1.43 (0.89)	0.622

VAS = visual analogue scale; M = mean (mean VAS score); SD = standard deviation.

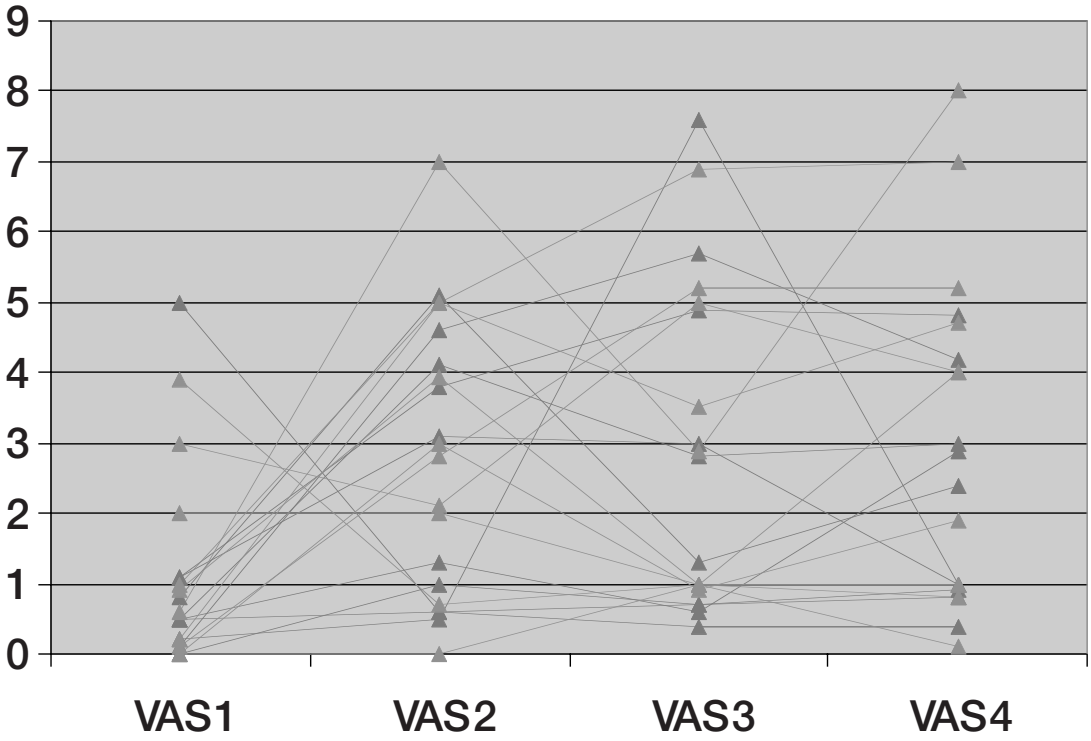

Figure 1
Individual scores for the pain measurements before the venipuncture, after the venipuncture and the expected pain for a future venipuncture.

VAS3ANXIETY) or regarding a fictitious venipuncture in the near future (VAS4PAIN, VAS4ANXIETY) ($p > 0.05$, table 1). Figure 1 shows the individual scores on all pain measurements.

The effects of anxiety and pain catastrophising on distraction

Based on a median split on the VAS for expected anxiety (VAS2ANXIETY) before venipuncture in the experimental group (median = 1.5) 'low-anxiety' children and 'high-anxiety' children were identified. The Mann-Whitney test showed that low- and high-anxiety groups differed significantly in experienced pain scores after venipuncture (VAS3PAIN) (figure 2). Highly anxious children reported significantly more pain than low-anxiety children ($p = 0.007$, Cohen's $d = 3.35$). This difference was already present before venipuncture, although not significant (VAS2PAIN, $p = 0.075$, Cohen's $d = 1.38$).

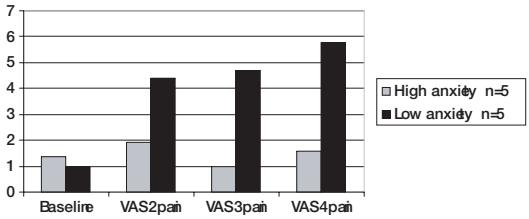

Figure 2
Mean pain scores for the high- and low-anxiety groups at four measurements, within the experimental group.

The results indicate that there is an effect of anxiety on reported and expected pain in the experimental group. Figure 2 shows an increase in pain between VAS2PAIN and VAS4PAIN for the highly anxious children, in contrast to the more stable pain measurements for the low-anxiety children in the experimental group. The Mann-Whitney-U shows that the difference in pain score between the two subgroups is statistically significant (MW = 2.5, $p < 0.05$, Cohen's $d = 1.75$). When the same tests in the control group were calculated, the results show no significant difference between the high-anxiety children and low-anxiety children. When we compare the 'distraction' – 'no distraction' groups, the results show a decrease in pain scores in the highly anxious children in the control group compared with the highly anxious children in the experimental group (MW = 2.0, $p < 0.05$, Cohen's $d = 1.78$). Low-anxiety children do not differ between the two groups (MW = 10, $p = 0.59$, Cohen's $d = 0.81$). It seems as though the distraction task results in more pain in the highly anxious children, when compared with the condition in which no distraction task was provided; however, the Mann-Whitney U shows that this increase is not significant (MW = 5.0, $p = 0.117$, Cohen's $d = 1.13$).

The same statistical procedure was followed to examine the differences in pain scores for the high-catastrophising and low-catastrophising groups. The median was 12. Although the same

pattern for high- versus low-catastrophising children was found as in high- versus low-anxiety groups, the difference in pain scores in the experimental group is not significant (figure 3) (MW = 29.0, $p = 0.0123$, Cohen's $d = 0.89$). Furthermore catastrophising scores of the children (PCS-C) did not correlate with those of the parents (PCS) (Spearman's Rho = –0.086; $p > 0.1$). Instead, the PCS-C correlated with experienced pain (VAS3PAIN) (0.475; $p < 0.05$) and expected pain after venipuncture (VAS4PAIN) (0.467; $p < 0.05$). This indicates that the more children catastrophise about pain, the more pain they experience after venipuncture and the more pain they expect from a venipuncture in the future.

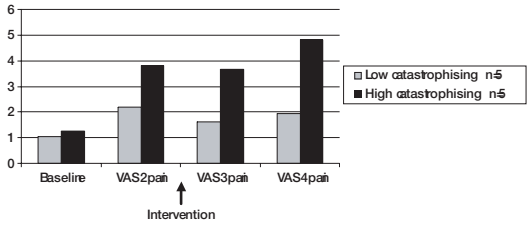

Figure 3
Mean pain scores for high and low catastrophisers in the experimental group at four measurements.

The effects of 'looking' on distraction

In the experimental group, the Mann-Whitney U test shows that the non-lookers report less pain after the venipuncture in comparison with the lookers ($p < 0.1$, Cohen's $d = 0.28$), but non-lookers expect more pain for a venipuncture in the future ($p < 0.1$, Cohen's $d = 0.61$) (figure 4). In other words non-lookers seem to expect more pain before the venipuncture, but when the venipuncture is completed their pain report equals that of the lookers.

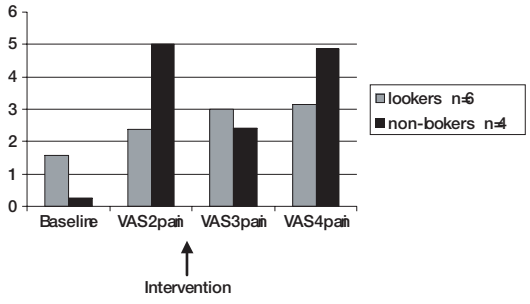

Figure 4
Mean pain scores for the lookers and non-lookers within the experimental group.

Regarding the anxiety reports the groups of lookers and non-lookers differ. Although the non-lookers again report more anxiety before the venipuncture, the difference is not statistically significant (figure 5) (MW = 2.5, $p = 0.067$, Cohen's $d = 1.41$). However, the non-lookers have lower anxiety scores and expect to be less anxious for a venipuncture in the future as compared with the lookers who show no changes in anxiety throughout all measurements (MWU 2.0, $p = 0.05$, Cohen's $d = 0.42$). Non-lookers seem to benefit more than lookers from the distraction task in decreasing their anxiety.

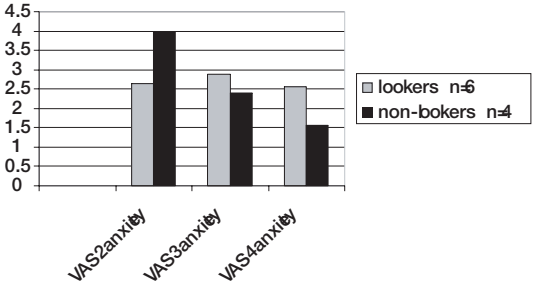

Figure 5
Mean anxiety scores for the lookers and non-lookers within the experimental group.

Discussion

We can conclude that we have not been able to confirm our first hypothesis. A distraction task did not result in a reduction in pain experience and anxiety in the experimental group, compared with the control group. This result is not in line with the results from other recent studies investigating distraction as an intervention for pain and anxiety (Broome et al., 1992; Lal, McClelland, Phillips, Taub & Beattie, 2001; (Mason, Johnson, & Woolley, 1999).

Our second hypothesis could only be partially confirmed. We could not completely validate our assumption that the intervention would particularly have an effect in children with low anxiety scores and low catastrophising. As predicted by the theory (Goodenough et al., 1997) the highly anxious children in the experimental group reported more pain than the less anxious children, but children with low anxiety levels did not show a significant reduction in experienced pain. Moreover, the low-anxiety children in the experimental group did not differ from those in the control group. For the highly anxious group, it seems that distraction has a pernicious effect. In the experimental group, the pain scores increased for highly anxious children after the distraction. Although the Mann-Whitney U test did not show a significant difference, the Cohen's d effect size does suggest that this difference between the two groups is considerable. For the second part of the hypothesis, where we looked at the comparison between high and low catastrophisers, we did not find convincing results either. The results showed the same trend as in the comparison between high and low anxiety, but the difference between the two groups was not significant.

The data partially support our third hypothesis that children who have the habit of looking to-

wards the venipuncture (lookers) are less easy to distract than the children who prefer not to look (non-lookers) and therefore benefit less from the intervention. The effect of the intervention is significant with regards to the anxiety measures, but not significant for the pain measures.

There are a number of factors that may have influenced our result. First, there is the small sample size of 20 children, of which only ten underwent distraction. Second, one could question our choice of intervention. We choose the picture puzzle based on the fact that this was a cognitive task. It could be questioned whether a picture puzzle is appealing enough for the children to elicit a positive emotion (McCaul et al., 1992). From our own experience, we can say that in both the preliminary study and during the data collection, both children and parents were enthusiastic about the picture puzzle we used. It was a new kind of toy for many children and it made them curious. Furthermore, absence of interaction with the parent during the distraction could play a role. In our study the parents were asked to hold the puzzle in place. They were specifically instructed not to help the child in any way. In the study by Mason et al. (1999), on the other hand, the parents were given a more active role. They were asked to read to the child from an interactive book. According to the investigators, this could lead to a decrease in anxiety in parents, which could in turn have a positive effect on the child's anxiety. This active role of parents in an intervention may prevent them from showing stressful behaviour. In this study, we opted for a non-active role for the parents to standardise the behaviour of the parents as much as possible.

Furthermore, we did not succeed in manipulating the attention. During a preliminary study we examined which picture puzzle was the most suitable to use to measure the amount of distraction and we chose a picture where the children needed at least ten minutes to complete the puzzle and find all the hidden items. By doing this, we made sure that we would not have to exclude any venipunctures because of the child completing the task too quickly. Based on the pilot study, the chance of finding an item within the average venipuncture time of 2:21 minutes was 79.41%. Nearly eight out of ten children in the pilot study found an item in the puzzle within this time. However, in our experiment only four children were able to find one item in the puzzle. Taking into consideration that the children in our study population were searching while undergoing venipuncture, one could question whether the success percentage would have been lower, as there was probably some amount of distraction from the venipuncture. Using a different method of measuring attention, for example by recording the venipuncture with a video camera, might have produced other results. Such a method may enable the researcher to register exactly how long the child looked at the distraction task. Finally, the results show that a venipuncture takes on average 2 minutes and 21 seconds. Therefore, we could have opted for a picture puzzle from the pilot study in which the items were easier to find.

The surprising result from the classification into lookers and non-lookers, namely that the non-lookers showed a substantial reduction in anxiety compared with the lookers, could be due to coping. These data could thus support the hypothesis by McCaul and Malott (1984) that distraction from an unpleasant stimulus is an effective coping strategy. It could further be hypothesised that it is easier to change the direction of the attention in non-lookers than in lookers, because the first group is already consciously choosing not to direct the attention towards the pain stimulus. Our finding should therefore be tested in a larger population.

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