

# Worry in Adults and Children: Developmental Differences in the Importance of Probability and Cost Judgments

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**Abstract** This study investigated developmental differences in the relationship of probability and cost estimates to worrying. Adults, younger children ( $M$  age=8.67 years) and older children ( $M$  age=11.06 years) rated the extent to which they worry about a list of negative social and physical outcomes and provided subjective probability and cost estimates for the same outcomes. Adults reported worrying more about social outcomes and rated them as less ‘bad’ (or costly) but more likely to occur than physical outcomes. Unlike adults, children in both age groups reported worrying more about physical outcomes. However, similar to adults, they also rated social outcomes as less ‘bad’ but more likely to occur than physical outcomes. Regression analyses showed that probability ratings were the best predictors of worry in adults, both probability and cost ratings equally predicted worry in older children, but only cost ratings predicted worry in younger children.

**Keywords** Worry · Anxiety · Probability · Cost · Adult · Child

Some worry is a normal part of everyday life. However, excessive worrying is a symptom of a wide range of psychological disturbance both in adults and children (American Psychiatric Association 2000; Kessler et al. 2005; Rapee and Barlow 1991; Sassaroli et al. 2005). Elucidating the developmental course of worry, therefore, can be a crucial step in reducing a variety of psychological problems throughout the life span. Cognitive theories propose that worry and anxiety are triggered by a perception of threat (e.g., Beck et al. 1985; Borkovec

et al. 2004; Mathews 1990) and may be further exacerbated by an inability to tolerate the uncertainty associated with possible future threat (Dugas et al. 2004). Consequently, the nature of threat perception has been an important target of empirical research in adults. However, much less is known about the cognitive factors associated with worry in youth.

Research involving adults has shown that the negative outcomes individuals worry about are best summarized in terms of two factors, reflecting social and physical threat. Negative social outcomes include embarrassment, humiliation or other types of social defeat, while physical outcomes include death, illness, or injury (Lovibond and Rapee 1993). Threat perception, and the extent of both normal and clinically significant worrying, are largely determined by individuals’ subjective evaluations of two aspects of the situation: the probability of the negative outcome occurring, and the cost (or aversiveness) of that outcome, should it occur (Beck et al. 1985; Berenbaum et al. 2007a; Butler and Mathews 1987; Mathews and MacLeod 1994; Rapee 1997; Uren et al. 2004). In everyday life, adults tend to worry more about negative events that they perceive as relatively more likely to occur, rather than about events that are relatively more aversive but less likely to occur (Berenbaum et al. 2007b; Campbell et al. 2000; Lovibond and Rapee 1993). Thus, normal, everyday worries reflect individuals’ changing life circumstances: worries about negative social outcomes are more predominant during the young adult years, but worries about physical outcomes, especially those related to health and illness, become more frequent in old age (Ladouceur et al. 2002; Lovibond and Rapee 1993; Wisocki 1994).

Relatively less is known about the nature and cognitive determinants of worrying in children. To date, the majority of research on children’s worries focused on documenting the negative outcomes that young people of different ages

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report worrying about (e.g., Campbell and Rapee 1994; Henker et al. 1995; Muris et al. 2000; Silverman et al. 1995). It has been found that, similar to adults, children worry about negative outcomes that are best summarized in terms of two underlying factors, reflecting social and physical threat (Campbell and Rapee 1994). Interestingly, however, unlike adults, school-aged children report worrying mainly about physical harm, such as becoming a victim of crime, natural disasters, or war, rather than about social embarrassment or failure (Campbell and Rapee 1994; Henker et al. 1995; Muris et al. 2000; Silverman et al. 1995). That is, unlike adults, children report worrying about outcomes that are highly aversive but unlikely to occur in their everyday lives. These reports suggest that common theoretical assumptions and empirical findings about worry and threat perception in adults may not be applicable to children.

Some researchers, however, have questioned the validity of these findings. Campbell et al. (2000) and McCathie and Spence (1991) have suggested that children's responses to worry list questionnaires do not reflect the extent to which they in fact worry about the events depicted in the questionnaire items. Instead, the responses largely reflect children's judgments of "how bad it would be" if the particular events actually occurred. In other words, worry list questionnaires are best seen as assessing children's subjective perceptions of the cost (or aversiveness) of negative outcomes, rather than their worrying. This pattern may be especially prevalent in 6–9-year-olds' responses, while 10–16-year-olds may be in a transitional stage towards interpreting the questionnaire items in a more adult-like manner (Campbell et al. 2000). However, there is evidence that children's reports of worrying about highly aversive physical events are not specific to questionnaire-based studies. Concerns about war, crime or disease regularly feature among children's most frequently reported worry topics in interview-based free-recall studies as well (Henker et al. 1995; Silverman et al. 1995; Muris et al. 2000). These findings are inconsistent with the 'limited-validity' hypothesis, as children in these latter studies were not responding to questionnaire items but recalling their own worries. Therefore, the predominance of highly aversive physical worry themes is not merely an artifact of the assessment method.

An alternative explanation for the difference between adults' and children's worry themes may be that children are unable to make realistic or accurate probability judgments. So, they may believe that becoming a victim of disaster, war, illness or crime are in fact events that are highly likely to occur, and such unrealistic judgments could then trigger worrying. Although it has been shown that children's ability to make probability judgments is substantially developed by elementary school age (Jacobs and

Klaczynski 2002; Reyna and Brainerd 1994), no research studies have yet specifically assessed their ability to make probability judgments about the events they report worrying about. There is only one study available (Silverman et al. 1995), in which 7–13-year-olds were asked to estimate the frequency (rather than subjective probability) of such events. Children reported to be aware of the relatively low frequency of war, crime or natural disasters occurring in the societies they live in, yet they also reported worrying the most about these events. In contrast, negative social events were rated as higher in frequency of occurrence, but less worried about. No age-related differences were found in frequency of event ratings, suggesting that children are aware of the relative frequency of a variety of harmful events from at least 7 years of age. Unfortunately, probability ratings were not collected in this study, leaving open the possibility that children do not use frequency estimates when they make subjective judgments about the probability of these events happening to them personally.

Nevertheless, the above results suggest a third possible explanation for the difference between adults' and children's worry themes. It is possible that even though young people are able to make realistic judgments about probability, such judgments do not play an important role in their threat perception and worry. Instead, their judgments about the cost of an outcome may be relatively more important. It is possible, for example, that children's metacognitive and emotion regulation skills are not well developed enough to enable them to divert their attention from the high aversiveness of a potential outcome to its lower likelihood. Indeed, such skills have been shown to emerge gradually through late childhood and adolescence (Gross 2001; Southam-Gerow and Kendall 2002). Although this explanation appears to be consistent with previous data, no empirical research has yet directly investigated whether there are any developmental differences in the relative importance of probability and cost judgments in explaining worry. Exploring this question was the overall aim of the present study.

First, the study aimed to replicate previous findings that young adults report worrying more about social than physical events and that they rate social events as more likely to occur but less aversive than physical events. It was expected that variability in adults' worry ratings would be explained by variability in both probability and cost ratings for negative events, but that probability ratings would play a relatively more important role. The same relationships were examined in school-aged children. It was expected that, unlike adults, children would report worrying more about physical than social events. However, similar to adults, they would rate social events as less aversive but more likely to occur than physical events. No differences between younger and older children were expected in this pattern. Most importantly, it was expected that probability

judgments would play a relatively less important role in explaining worry in children than in adults. Such role would be more important in older children than in younger children, indicating a developmental trajectory towards the emergence of an adult-like worry process later in adolescence.

## Method

### Participants

**Adults** The sample of young adults included in the study comprised of 42 first year university students, 19 men and 23 women, who received course credit for participation. The participants' mean age was 18.90 years ( $SD=2.01$ ,  $N=40$  participants reported their age), with no significant difference between men and women in age ( $t(38)=.11$ ).

**Children** Two groups of children took part in the study, approximating the age ranges included in previous relevant research. The younger group had a mean age of 8.67 years ( $SD=.66$ ,  $Min=6.92$ ,  $Max=9.50$  years). There were 62 children in this group, 27 boys and 35 girls. There was no significant age difference between boys and girls ( $t(60)=.05$ ,  $p>.05$ ). The older group included 85 children, 45 boys and 40 girls, with a mean age of 11.06 years ( $SD=.75$ ,  $Min=10.00$ ,  $Max=12.67$ ), with no significant age difference between boys and girls ( $t(83)=.75$ ,  $p>.05$ ). There was no significant difference in gender distribution between the younger and older age groups (Pearson  $\chi^2=.26$ ,  $p>.05$ ).

The children were recruited from independent metropolitan primary schools, located in suburbs with a middle-to-high range of incomes and predominantly European ancestry (Australian Bureau of Statistics 2002). Information on ethnic background was available from 63 children. Of these children, 52 (82%) were classified as Caucasian, 8 (13%) as Asian, and 3 (5%) as Arabic or North-African. The average response rate in this study was 27%, which is highly similar to the response rates previously reported in studies investigating worry or anxiety in children (Suarez and Bell-Dolan 2001; Szabó and Lovibond 2004). Average worry and outcome judgment scores in the present sample were similar to those reported previously (Campbell and Rapee 1994; Campbell et al. 2000), suggesting that self-selection bias was unlikely to influence the data.

### Materials

As in previous research (Campbell et al. 2000), the original and two modified versions of the *Physical Social Outcome Questionnaire* (PSOQ, Lovibond and Rapee 1993) and the *Child and Adolescent Worry Scale* (CAWS, Campbell and

Rapee 1994) were employed to maximize comparability between data collected from adults and children. The two questionnaires were developed using highly similar aims and strategies. Both were found to have two underlying factors, one relating to physical outcomes and the other to social outcomes. On both questionnaires, physical outcomes include death, pain and physical injury, and social outcomes include social embarrassment, loneliness and negative evaluation. Although there are several items that are included on both questionnaires (i.e., dying, being criticized, being laughed at), there are also differences in item content that reflect the different life experiences, knowledge and specific concerns of adults and children (e.g., the adult version refers to specific illnesses such as having a heart attack or being paralyzed, while the child version refers to experiences such as 'not being able to breathe' or 'being in a wheelchair'). The original and modified versions of these questionnaires were used to obtain worry, probability and cost ratings from adults and children.

The *Physical Social Outcome Questionnaire* (PSOQ; Lovibond and Rapee 1993) is a 24-item scale developed to assess the extent to which adults worry about a range of negative outcomes. Its two underlying factors comprise 12 items relating to Physical outcomes and 12 items relating to Social outcomes. Initial evidence for the reliability and validity of the PSOQ was reported by Lovibond and Rapee and include Cronbach's alpha coefficients of .88 for the Physical subscale and .87 for the Social subscale, and significant positive correlations between the Physical subscale and the Anxiety Sensitivity Index (Reiss et al. 1986), and between the Social subscale and the Fear of Negative Evaluation Scale (Watson and Friend 1969). The original version of the PSOQ asks participants to indicate the extent to which they worry about the particular outcomes depicted in the items happening to them, using a five-point scale between 0 = 'Never crosses my mind' and 4 = 'Worry about it constantly/repeatedly'. The scale yields a total worry score ranging from 0 to 96, and separate scores for Physical and Social outcomes ranging between 0 and 48 on each scale. The phrase "in the next year" was added to the original instruction to maximize comparability with the two modified versions, as described below.

The modified versions included the same items as the original version, but the wording of the instructions and the response formats were changed. As the 'worry' version, the modified versions yielded total scores between 0 and 96 (0–48 on the Physical subscale and 0–48 on the Social subscale). The first modification aimed to assess the perceived cost (or aversiveness) of the listed items and was originally developed by Lovibond and Rapee (1993). The participants were asked to indicate "how bad it would be for you if that event happened to you in the next year". The response options ranged between 0 = 'Undesirable' and 4 = 'The

worst sort of thing that could happen'. Two previous studies (Campbell et al. 2000; Lovibond and Rapee 1993) provided initial psychometric data for the 'Bad' version of the PSOQ, showing a stable 2-factor structure, internal consistency of .87 for the scale as a whole, and significantly higher 'bad' ratings for the Physical compared to the Social subscale. The second modification of the PSOQ, developed for the purposes of this study, asked the participants to indicate "how likely it is that the event will happen to you in the next year", with responses ranging between 0 = 'Not at all likely' and 4 = 'Almost certain'. The phrase 'in the next year' was included because pilot participants had pointed out that the likelihood of most events listed on the PSOQ happening at some time in the future is 100% (i.e., dying, getting sick).

The *Child and Adolescent Worry Scale* (CAWS; Campbell and Rapee 1994) was developed to assess the extent to which 6–16-year-old children and adolescents worry about a range of negative outcomes. Its two underlying factors comprise 9 Physical and 11 Social negative outcomes. The psychometric properties of the CAWS include 3-month test-retest reliability coefficients of .82 for the Physical and .71 for the Social subscale, and significant positive correlations with such measures of fear and anxiety as the FSSC-R (Ollendick 1983) and the RCMAS (Reynolds and Richmond 1978). The original version of the CAWS (Campbell and Rapee 1994) asks children to indicate how much they worry about each of the listed outcomes on a 3-point scale, where 0 = 'Don't really worry' and 2 = 'Worry a lot'. The questionnaire yields a total worry score between 0 and 40, and separate scores for Physical and Social outcomes (0–18 on the 9-item Physical subscale and 0–22 on the 11-item Social subscale).

Similarly to the PSOQ, modified versions of the CAWS were developed to enable child participants to indicate "how bad it would be", and "how likely it is" that the listed events would happen to them within the next year. The items remained the same but the wording of the instructions and responses were changed to produce the two modified versions. The responses for the 'Bad' version ranged from 0 = 'Not really bad' to 2 = 'Very Bad', and for the 'Likely' version from 0 = 'Not really likely' to 2 = 'Very likely'. The modified versions also yielded total scores between 0 and 40 (0–18 on the 9-item Physical subscale and 0–22 on the 11-item Social subscale). Campbell et al. (2000) provided initial psychometric data obtained from 6–16-year-old respondents for the 'Bad' version of the CAWS. These include a stable factor structure, internal consistency estimates ranging from .68 to .95, and higher 'bad' ratings for the Physical compared to the Social subscale in all age groups.

#### Procedure

The study was conducted after gaining relevant approvals from institutional ethics committees and the principals of

participating schools. The study was presented as an investigation of the judgments adults and children make about the negative outcomes they worry about. Adult participants were recruited via a university-based system where students volunteer to take part in studies of their choice in return for course credit. Students who gave written consent to take part in the study were asked to complete the original 'Worry' version of the PSOQ and the two modified ('PSOQ-Bad' and 'PSOQ-Likely') versions. They completed the questionnaires in groups of 10–20. Child participants were recruited via their schools. All children in grades 2–6 were invited to take part, and they were offered no additional incentives for participation. A parental information letter and consent form was sent home with each potential child participant from their schools. Only children who gave their own and their parents' written consent on the day of data collection took part in the study. They filled in the questionnaires in small groups in a private room in school. Each child participant was asked to complete the original 'Worry' version of the CAWS and the two modified ('CAWS-Bad' and 'CAWS-Likely') versions. A research assistant was present to explain the procedure and answer questions. As in previous research (e.g., Campbell and Rapee 1994; Campbell et al. 2000), the items were read out to the youngest children to reduce the potential influence of reading ability on the pattern of results. The order of presentation of the questionnaires was counterbalanced both in the adult and child groups, to minimize the influence of any order effects on the data.

## Results

### Psychometric Properties of the Questionnaires

Exploratory factor analyses were conducted on all three versions of the CAWS and the PSOQ to ascertain that the items in the different versions consistently loaded on the same physical and social factors. Principal Axis Factoring with Direct Oblimin rotation was employed to allow the two extracted factors to correlate (Fabrigar et al. 1999). Consistent with previous findings (Campbell and Rapee 1994; Campbell et al. 2000; Lovibond and Rapee 1993) scree plot tests indicated that a two-factor solution provided the best description of the data in each of the factor analyses.

On the original 'Worry' version of the CAWS, the first two factors accounted for 39.73 and 15.96% of the variance, respectively. The first factor consisted of the 9 Physical items, with item loadings between .86 ('being killed in war') and .54 ('breaking an arm or leg'). The second factor consisted of the remaining 11 Social items, with factor loadings between .68 ('people being nasty to you') and .43 ('being criticized'). Using the criterion of .35

for loading on a factor, no cross-loading or double-loading items were identified.

Similar results were obtained for the ‘Likely’ version of the CAWS. The first two factors explained 29.58 and 14.99% of the variance, respectively. The first factor consisted of the 11 Social items, with factor loadings between .72 (*‘people being nasty to you’*) and .43 (*‘not having any friends’*). The second factor consisted of the 9 Physical items, with item loadings between .80 (*‘being killed in war’*) and .38 (*‘being burnt’*). Only one of the 20 items had a loading above .35 on both factors (*‘not having any friends’* loaded .43 on the Social and  $-.39$  on the Physical factor).

On the ‘Bad’ version of the CAWS, the first two factors explained 28.35 and 13.52% of the total variance, respectively. Factor 1 consisted of the 11 Social items, with factor loadings ranging from .75 (*‘people being nasty to you’*) to .36 (*‘making a mistake’*). Factor 2 consisted of 7 Physical items with loadings above .35, ranging from .68 (*‘dying’*) to .40 (*‘breaking an arm or leg’*). In this analysis, two of the original Physical subscale items failed to load substantially on either factor. *‘Not being able to breathe’* had a loading of .34 on the Physical and .28 on the Social factor, and *‘being burnt’* had a loading of .22 on the Physical and .28 on the Social factor. No substantial cross-loadings were observed. These analyses were repeated in the two age groups separately, and similar patterns were obtained in both older and younger children.

The same factor analytic technique was used to examine the underlying structure of the Worry, Bad and Likely versions of the PSOQ in adults. Each of the three versions was found to have a clear two-factor structure, and all items loaded on their expected Social or Physical factors. The only exception from this pattern was that in the Worry version, the item *‘going insane’* had a loading of .49 on the

Physical and .39 on the Social subscale. No other cross loading or double loading items were observed.

Reliability estimates (Cronbach’s coefficient alphas) were computed for the three (Worry, Bad and Likely) versions of the PSOQ and the CAWS. As the results in Table 1 show, internal consistency estimates were generally high. The lowest reliability estimate was .67 (for the ‘Bad’ version of the CAWS in the younger children’s group), which was considered acceptable for a brief measure (Cronbach 1990). Deletion of items that received low loadings in the factor analyses (e.g., *‘being burnt’* in the ‘Bad’ version of the CAWS) did not change internal consistency estimates. Therefore, all items were retained in all subsequent analyses.

Worry, Probability, and Cost Ratings in Adults and Children

Social and Physical subscale scores were calculated for the Worry, Bad and Likely versions of the PSOQ for adults and the Worry, Bad and Likely versions of the CAWS for children. Multivariate Analyses of Variance (MANOVAs) were conducted to examine whether Worry, Bad and Likely ratings differ between Social and Physical outcomes in adults and children.

Adults’ PSOQ scores are presented in Table 2. A repeated measures MANOVA was carried out with Social vs. Physical outcome focus as a within-subjects factor and PSOQ-Worry, PSOQ-Bad and PSOQ-Likely scores as dependent measures.<sup>1</sup> The multivariate test of the within subjects factor was significant ( $F(3, 38)=83.55, p<.001, \text{Partial } \eta^2=.87$ ), and was followed by Univariate  $F$  tests to examine which of the three dependent measures (i. e., Worry, Bad, or Likely ratings) was affected by outcome focus. The results of the Univariate  $F$  tests showed that adults reported worrying more about Social outcomes than Physical outcomes ( $F(1, 40)=58.93, p<.001, \text{Partial } \eta^2=.60$ ), rated Social outcomes as less ‘Bad’ than Physical outcomes ( $F(1, 40)=24.09, p<.001, \text{Partial } \eta^2=.38$ ), and rated Social outcomes as more ‘Likely’ to occur than Physical outcomes ( $F(1, 40)=148.05, p<.001, \text{Partial } \eta^2=.79$ ).

The next analyses examined the same question in children. In addition to testing whether children’s worry, probability and cost judgments differ between social and physical outcomes, the effect of age upon these judgments was also examined. Because the Physical and Social

**Table 1** Internal consistency estimates (Cronbach’s alpha) for the worry, bad and likely versions of the PSOQ and the CAWS

	Total	Social	Physical
Adults			
PSOQ-worry	.91	.93	.94
PSOQ-bad	.88	.91	.93
PSOQ-likely	.91	.88	.93
Older children			
CAWS-worry	.92	.89	.93
CAWS-bad	.88	.89	.81
CAWS-likely	.88	.89	.81
Younger children			
CAWS-worry	.91	.85	.93
CAWS-bad	.83	.83	.67
CAWS-likely	.85	.74	.86

PSOQ Physical Social Outcome Questionnaire (Lovibond and Rapee 1993), CAWS Child and Adolescent Worry Scale (Campbell and Rapee 1994)

<sup>1</sup> Preliminary MANOVAs revealed no main effect of gender on worry, probability, or cost ratings in adults, although a small interaction effect showed that women worry relatively more about social outcomes. No significant main or interaction effects of gender were found in the child sample. Therefore, gender was not included in any further analyses.

**Table 2** Mean social and physical subscale scores obtained by the adult sample on the worry, bad and likely versions of the PSOQ

	Mean	SD
PSOQ social worry	27.61	10.13
PSOQ physical worry	11.33	10.18
PSOQ social bad	17.46	10.17
PSOQ physical bad	29.27	11.58
PSOQ social likely	25.63	8.48
PSOQ physical likely	7.07	8.29

PSOQ Physical Social Outcome Questionnaire (Lovibond and Rapee 1993)

subscales of the CAWS contain unequal numbers of items (9 Physical and 11 Social items), average subscale scores were calculated to enable direct comparisons between social and physical ratings. Table 3 presents the mean subscale scores children obtained on the Worry, Bad and Likely versions of the CAWS, for the total group and for the younger and older children separately.

A mixed-measures MANOVA was carried out with CAWS-Worry, CAWS-Bad and CAWS-Likely scores as dependent measures, Social vs. Physical outcome focus as a within-subjects factor and Age Group as a between subjects factor. The multivariate tests of both the between subjects factor ( $F(3, 142)=4.06, p<.01, \text{Partial } \eta^2=.08$ ) and the within subjects factor ( $F(3, 142)=177.66, p<.001, \text{Partial } \eta^2=.79$ ) were significant. There was no significant multivariate interaction between Age Group and Social vs. Physical focus ( $F(3, 142)=1.86, p>.05$ ), suggesting that any differences between the Social and Physical subscales were similar in magnitude in the two age groups on each of the Worry, Bad and Likely versions of the CAWS.

Univariate  $F$  tests were conducted to follow up the significant multivariate tests. The results of the between subjects Univariate  $F$  tests showed that compared to younger children, older children rated the likelihood of negative outcomes slightly higher in general ( $F(1, 144)=4.26, p<.05, \text{Partial } \eta^2=.03$ ), but no other significant age-related differ-

ences were found. The results of the within subjects Univariate  $F$  tests suggested that all children reported worrying more about Physical outcomes than Social outcomes ( $F(1, 144)=45.24, p<.001, \text{Partial } \eta^2=.24$ ), rated Social outcomes as less 'bad' than Physical outcomes ( $F(1, 144)=401.08, p<.001, \text{Partial } \eta^2=.74$ ), and rated Social outcomes as more likely to occur than Physical outcomes ( $F(1, 144)=164.41, p<.001, \text{Partial } \eta^2=.53$ ).

The results of the analyses reported above indicate that adults worry more about social than physical outcomes, while children worry more about physical than social outcomes. This pattern is present even though both adults and children judge social outcomes as relatively more likely to occur and physical outcomes as relatively more aversive (or costly). To illustrate this pattern, the five highest and five lowest rated items from the Worry, Bad and Likely versions of the CAWS and the PSOQ are listed in Tables 4 and 5.

#### Relationships Among Worry, Probability and Cost Ratings in Adults and Children

After examining the evidence for children's tendency to worry about highly aversive outcomes that are unlikely to occur and their ability to make judgments about the probability and cost of such outcomes, the next analyses aimed to investigate the role of probability and cost judgments in predicting worry, and any possible changes in such role with age. To that end, sequential multiple regression procedures were employed (Keith 2006).

In the adult group, PSOQ-Likely and PSOQ-Bad ratings were both positively associated with PSOQ-Worry (Pearson  $r_s=.68$  and  $.52$ , respectively,  $ps<.001$ ), as well as with each other (Pearson  $r=.32, p<.05$ ). A sequential multiple regression analysis was conducted to examine the relative importance of probability and cost judgments in predicting worry in adults, while controlling for the relationship between probability and cost ratings. The criterion variable was PSOQ-Worry. PSOQ-Bad was entered as a predictor in the first step, and PSOQ-Likely was entered as a predictor at the second step. PSOQ-Bad ratings accounted for 27% of

**Table 3** Mean social and physical subscale scores obtained by children on the worry, bad and likely versions of the CAWS

	Older ( $n=85$ )		Younger ( $n=61$ )		Total ( $N=146$ )	
	Mean	SD	Mean	SD	Mean	SD
CAWS social worry	.75	.47	.83	.47	.78	.47
CAWS physical worry	1.04	.69	1.27	.68	1.14	.69
CAWS social bad	.99	.45	.97	.42	.98	.44
CAWS physical bad	1.72	.33	1.70	.30	1.71	.32
CAWS social likely	.82	.47	.64	.33	.74	.42
CAWS physical likely	.28	.32	.25	.36	.27	.33

CAWS Child and Adolescent Worry Scale (Campbell and Rapee 1994)

**Table 4** Highest and lowest rated items by adults on the worry, bad and likely versions of the PSOQ

PSOQ-worry	M	SD	PSOQ-bad	M	SD	PSOQ-likely	M	SD
Highest rated								
Failing study	2.69	1.14	Brain damage	3.07	1.35	Laughed at	2.83	1.19
Not succeeding	2.64	1.08	Paralyzed	2.98	1.20	Being criticized	2.69	1.18
Letting others down	2.57	.97	Loosing a limb	2.95	1.10	Things going wrong	2.67	1.00
Things going wrong	2.45	1.09	Cancer	2.79	1.18	Looking stupid	2.57	1.02
Being criticized	2.38	1.19	Heart attack	2.62	1.27	Personality flaws	2.17	1.15
Lowest rated								
Shot/stabbed	.74	1.06	Humiliated	1.10	1.19	Paralyzed	.43	.83
Heart attack	.74	1.08	Being criticized	1.10	1.36	Shot/stabbed	.38	.79
Brain damage	.71	1.04	Personality flaws	1.07	1.00	Heart attack	.38	.85
Loosing limb	.60	.96	Looking stupid	.90	1.23	Loosing limb	.38	.82
Bashed	.60	.73	Laughed at	.83	1.03	Brain damage	.36	.76

the variance in PSOQ-Worry ( $R^2=.27$ ,  $F(1, 37)=13.94$ ,  $p<.001$ ) at the first step. The addition of PSOQ-Likely ratings significantly increased the variance explained in PSOQ-Worry ( $R^2$  change=.30,  $F$  change (1, 36)=24.88,  $p<.001$ ), with the final model accounting for 57% of the variance in PSOQ-Worry ( $F(2, 36)=23.91$ ,  $p<.001$ ). Both PSOQ-Bad and PSOQ-Likely ratings made a significant unique contribution to the prediction of PSOQ-Worry at the last step, but PSOQ-Likely ( $\beta=.57$ ,  $t=4.99$ ,  $p<.001$ ) explained a relatively larger amount of variance than did PSOQ-Bad ( $\beta=.34$ ,  $t=2.97$ ,  $p<.01$ ).

In children, CAWS-Likely and CAWS-Bad ratings were both positively associated with CAWS-Worry (Pearson  $r_s=.24$  and  $.41$ ,  $ps<.005$  and  $.001$ , respectively), as well as with each other ( $r=.25$ ,  $p<.005$ ). A moderated sequential multiple regression analysis was carried out next, with CAWS-Worry as the criterion variable. In addition to

examining the relative importance of cost and probability judgments in predicting worry, this analysis also tested whether the strength of the relationship of children’s worry ratings to their probability and cost judgments changes with increasing age. To maximize power, age was entered as a continuous variable in the regression equation, rather than dichotomized into two (younger and older) groups (Cohen 1983; Keith 2006). Age was entered as a predictor at the first step, CAWS-Bad ratings were entered in the second step, and CAWS-Likely ratings in the third step. A significant increase in variance explained from the second to the third step would suggest that children do not only respond to worry questionnaires in terms of their judgments of ‘how bad’ an outcome would be if it really occurred, but that they also take subjective probability judgments into account. The possible interaction of age with probability and cost judgments in predicting worry was tested in the final two steps.

**Table 5** Highest and lowest rated items by children on the worry, bad and likely versions of the CAWS

CAWS-worry	M	SD	CAWS-bad	M	SD	CAWS-likely	M	SD
Highest rated								
Dying	1.35	.87	Dying	1.93	.34	Making a mistake	1.32	.71
Unable to breathe	1.31	.83	War	1.90	.36	Being laughed at	.84	.67
Car accident	1.21	.81	Unable to breathe	1.83	.46	Looking silly	.77	.67
War	1.17	.93	Drowning	1.79	.52	Not looking good	.74	.66
Being blind	1.17	.90	Car accident	1.77	.50	Being teased	.74	.67
Lowest rated								
Nobody to play with	.75	.67	Being criticized	1.03	.72	Wheelchair	.19	.46
Making a mistake	.68	.69	Looking silly	.79	.75	Drowning	.17	.43
Not looking good	.66	.67	Being laughed at	.79	.71	Being blind	.17	.47
Being laughed at	.63	.70	Not looking good	.67	.67	Dying	.17	.47
Looking silly	.53	.66	Making a mistake	.47	.55	War	.12	.44

Cross product terms were created after centering the relevant variables to reduce multicollinearity (Keith 2006). The cross product of Age and CAWS-Bad scores was entered into the equation at the fourth step, and the cross product of Age and CAWS-Likely scores was entered at the fifth step. A significant increase in variance explained at either of these steps would suggest that the role of Bad and Likely ratings in explaining Worry varies with children's age. The results obtained at each step of the moderated sequential multiple regression analysis are presented in Table 6.

Table 6 shows that age had a small but significant negative relationship with worry, explaining 3% of the variance in worry scores when no other variables were entered into the equation. Entering CAWS-Bad and CAWS-Likely ratings each significantly increased the variance explained in CAWS-Worry. The interaction between age and CAWS-Bad ratings did not increase the variance explained by the model. However, the interaction between age and CAWS-Likely ratings resulted in a significant increase in variance explained, showing that the role of probability judgments in explaining worry increases with age. To illustrate this significant interaction, regression equations were conducted in the two age groups separately (Keith 2006). CAWS-Bad and CAWS-Likely ratings were entered to predict CAWS-Worry scores in younger and older children. As Table 7 shows, the equations explained a significant amount of variance in CAWS-Worry scores in both younger ( $R^2=.24$ ,  $F(2, 58)=9.24$ ,  $p<.001$ ) and older

**Table 6** Sequential multiple regression analysis predicting CAWS-worry scores in children (N=147)

Model	Predictors	$R^2$	$R^2 \Delta$	$F \Delta$	$\beta$	$t$
1	Age	.03	.03	4.85*	-.18	-2.20*
2	Age CAWS-bad	.19	.16	28.53***	-.17 .40	-2.31* 5.34***
3	Age CAWS-bad CAWS-likely	.23	.04	6.07*	-.21 .35 .19	-2.79** 4.63*** 2.46*
4	Age CAWS-bad CAWS-likely Age *CAWS-bad	.23	.00	.66	-.20 .36 .19 -.06	-2.58* 4.69*** 2.46* -.81
5	Age CAWS-bad CAWS-likely Age *CAWS-bad Age *CAWS-likely	.25	.02	4.24*	-.15 .36 .17 -.08 .16	-1.94 4.68*** 2.21* -1.00 2.06*

\*\*\* $p<.001$ , \*\* $p<.01$ , \* $p<.05$

**Table 7** Multiple regression equations predicting CAWS-worry scores in younger ( $M=8.67$  years) and older ( $M=11.06$  years) children

	Predictors	$R^2$	$\beta$	$t$
Younger	CAWS-bad	.24	.48	4.14***
	CAWS-likely		.03	.25
Older	CAWS-bad	.22	.27	2.67**
	CAWS-likely		.31	3.04**

\* $p<.05$ , \*\* $p<.01$ , \*\*\* $p<.001$

children ( $R^2=.22$ ,  $F(2, 81)=11.26$ ,  $p<.001$ ). Most importantly, as predicted on the basis of the significant interaction between age and CAWS-Likely ratings in the previous equation, the size of the regression coefficients associated with CAWS-Bad and CAWS-Likely ratings differed between the two age groups. CAWS-Likely ratings made no significant contribution to the prediction of CAWS-Worry in younger children over and above the contribution of CAWS-Bad ratings. In older children, however, both CAWS-Bad and CAWS-Likely ratings made independent contributions, and the size of the regression coefficients associated with these ratings were similar to each other.

## Discussion

The present study aimed to explain previous findings that, unlike adults, children worry excessively about such physical outcomes as becoming a victim of crime, war or natural disasters (Campbell and Rapee 1994; Silverman et al. 1995). It was proposed that these findings would best be explained by developmental differences in the relative importance of probability and cost judgments in predicting worry. To test this proposition, the association of worrying with probability and cost judgments was examined in adults and two groups of children. As expected, adults reported worrying more about social threat than about physical threat, and judged physical outcomes as more aversive but less likely to occur than social outcomes. Further, multiple regression equations showed that adults who reported worrying more about particular outcomes also gave relatively higher estimates of both the probability and cost of those outcomes. However, probability estimates played a relatively more important role than cost estimates in explaining worry ratings. These findings were consistent with previous theoretical propositions and empirical findings regarding worry and threat perception in adults (e.g., Beck et al. 1985; Berenbaum et al. 2007b; Lovibond and Rapee 1993; Mathews 1990).

A different pattern of results was expected concerning children's worry, probability, and cost judgments. First, it



was expected that unlike adults, children would report worrying mainly about physical outcomes (e.g., Campbell and Rapee 1994; Silverman et al. 1995). The results supported these predictions; both younger and older children provided relatively higher worry ratings for physical outcomes. For example, while adults' highest rated worries included such events as 'failing study' or 'being criticized', children rated 'dying' or 'war' as their most worried about topics. Second, it was expected that, similar to adults, children would rate social outcomes as more likely to occur but less aversive than physical outcomes (Campbell et al. 2000; Silverman et al. 1995). Accordingly, both adults and children rated such outcomes as 'being laughed at' or 'making a mistake' as the most likely to happen but least aversive, and such outcomes as 'being paralyzed' or 'dying' as the least likely to happen but most aversive. Consistent with developmental research showing that children's ability to make probability judgments is substantially developed by elementary school age (Jacobs and Klaczynski 2002; Reyna and Brainerd 1994), no differences were found in the pattern of ratings between older and younger children.

The central hypotheses in this study were that probability judgments would play a relatively less important role in explaining worry in children compared to adults, and that they would play a less important role in younger compared to older children. Again, the results were consistent with these expectations. Regression analyses revealed that, as in adults, both cost and probability ratings made a significant unique contribution to the explanation of variance in children's worry ratings. However, while the addition of probability ratings to the equation explained a further 30% of the variance in adults' worry ratings, the addition of probability ratings only increased the explained variance in children's worry ratings by 4%. Moreover, the significant interaction effect between age and probability judgments in the regression model suggested that the role of probability judgments in explaining worry increases as children mature. Accordingly, follow up analyses indicated that while the extent of worrying about negative outcomes was associated with both probability and cost judgments equally in 10–12-year-olds, younger children's extent of worrying was associated with their cost judgments only.

Taken together, the results of the multiple regression analyses have shown that a one standard deviation unit increase in probability ratings was associated with a .57 standard deviation unit increase in worry in adults, while the corresponding increase in worry was .31 standard deviation units in 10–12-year-olds, and no significant increase in 7–9-year-olds. The difference between adults and older children in the importance of probability judgments could explain the finding that all children, including the older age group, reported worrying mainly about

physical outcomes. A predominantly social focus of worries observed in adolescents and young adults (e.g., Ladouceur et al. 2002; Lovibond and Rapee 1993) is likely to develop only when subjective estimates of the probability of negative outcomes become the primary determinants of worrying. The present results suggest that this process fully develops only sometime after 12–13 years of age. The pattern of relationships found in the younger age group also has important theoretical and practical implications. Younger children were found to worry about events that they consider to be 'bad', and their knowledge about the low probability of those events occurring does not influence the extent to which they worry about them. It appears, therefore, that any effect of probability judgments on worry begins to develop sometime after 9–10 years of age, perhaps when children's increasing metacognitive and emotion regulation skills allow such judgments to be taken into account (Gross 2001; Jacobs and Klaczynski 2002; Southam-Gerow and Kendall 2002).

Previous alternative explanations for the finding that children worry predominantly about outcomes related to death or physical injury also need to be considered in light of the present data. The first of these explanations suggested that when responding to worry list questionnaires, children, especially those younger than 10 years of age, largely report their estimates of 'how bad' the events depicted in the questionnaire items would be if they really happened, rather than the extent to which they in fact worry about those events (Campbell et al. 2000; McCathie and Spence 1991). This suggestion was not supported by the present results, however. Specifically, if younger children were unable to differentiate between worry and cost judgments, than an especially high positive relationship would be expected between CAWS-Worry and CAWS-Bad ratings in the younger age group. This expectation was not borne out by the data: the moderated regression analysis revealed no significant interaction between cost judgments and children's age; the size of the regression coefficients associated with cost was moderate in each of the three age groups. The second alternative explanation may be that children, and especially younger children, are not able to make probability judgments. Again, the results did not support this proposition: all participants, including younger children, rated social outcomes as more likely to occur than physical outcomes, indicating an ability to make realistic probability judgments. Instead, it was the importance of the role such judgments play in explaining worry that differed between adults, older children, and younger children. Although the results of this study were in general consistent with its hypotheses, the data need to be considered in light of the study's limitations. The methodology may be criticized for its use of different measures for adults and children, which precluded the use of direct statistical

comparisons across these groups. An alternative strategy may have been to use the same items for all age groups. However, the same items can have different meanings or might be more or less familiar to adults and children, rendering their comparability highly questionable. Using questionnaires that were developed to assess the same construct in adults and children appeared to be a more defensible strategy, therefore. It is also important to acknowledge that the results obtained using worry list questionnaires in this study cannot be generalized to other data collection methods. Future studies using free recall interviews or worry-diaries are needed to extend the generalizability of the findings. Finally, longitudinal designs are now necessary to replicate the age-related differences observed in the present cross-sectional study.

In summary, the data obtained in this research have revealed that the association of worrying to subjective probability and cost estimates observed in adults has not yet fully developed in school-aged children. Probability judgments play a less important role in explaining worry in 10–12-year-olds than in adults, and they play no substantial role in explaining worry in younger children. Researchers and clinicians need to be mindful of the possibility that the nature and determinants of worry in youth may be different from those in adults, and that commonly held theoretical assumptions about worry in adults may not be applicable to children. An adult-like worry process, characterized by a predominantly social focus, verbal thinking, problem solving attempts and a cognitive avoidance function is likely to appear sometime during adolescence (Borkovec et al. 2004; Szabó 2007; Szabó and Lovibond 2002, 2004). Delineating the specific characteristics and determinants of worry in preadolescents still awaits future research.

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