Abstract
It has been suggested that cognitive development affects the emotional experience of children, including anxiety. However, an evidence review is needed to extract cognitive prerequisites that contribute to the development of anxiety in children. The purpose of the study is to explore evidence on cognitive prerequisites involved in experiencing anxiety in children. Four electronic databases of Scopus, OVID-PsycINFO, PubMed, and ScienceDirect were comprehensively searched for 1900 to 2018, yielding 4,618 articles. According to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) and inclusion and exclusion criteria, 25 articles were found as eligible. The analysis of literature identified 3 themes, including threat perception, future thinking, and generalization. It is suggested that these cognitive abilities may underlie anxiety. These results have important implications for better understanding the effect of cognitive prerequisites in anxiety phenomena and also could shed light on the explanation of anxiety in some disorders characterized by deficits in cognitive development.

Keywords: Children; Cognitive ability; Anxiety; Cognitive development; Cognitive prerequisites.

DOI: 10.22037/ijcn.v16i4.31467

Introduction
Anxiety disorders are among the most prevalent psychological disorders, affecting nearly 6.5% of children and adolescents worldwide (1). Theories of emotional development argue that cognitive development plays an important role in emotions, including anxiety (e.g., 2,3). Some researchers examined the relationship between cognitive development and anxiety in children. They indicated that normal children reported more anxiety than children with below-average intellectual abilities,
and there was a positive relationship between cognitive development and the level of anxiety (4–6). Karpinski et al. (7) argued that cognitive ability makes individuals respond to environmental stressors by worry, and worry is a positive risk factor for psychological disorders, particularly anxiety. In the same vein, Penney et al. (8) found that worry is associated with higher cognitive ability. Worry is considered a transdiagnostic construct (9) and is a common feature in many anxiety disorders (10). Studies on children with autism spectrum disorder (ASD) also found a positive relationship between cognitive ability and the level of anxiety (11,12). Some researchers examined the relationship between cognitive ability and anxiety; however, they considered cognitive ability in the context of cognitive development, and most of them utilized intelligent measures to assess cognitive abilities (e.g., 4–6). Just a few researchers indirectly mentioned some specific cognitive abilities that can influence the development of anxiety phenomena. Vasey (13) believed that to worry, a child must be able to anticipate future events. Also, some research findings indicated that highly anxious children, in comparison to their non-anxious counterparts, showed increased anticipation of negative emotions (e.g., 14,15). Making a prediction is a cognitive skill that undergoes significant development during the first 5 years of life (16). Additionally, Broeren and Muris (5) emphasized the fact that anxiety is rooted in threat, and the threat must be conceptualized, which conceptualization relays on cognitive abilities (17). Taken together, along with cognitive development, cognitive abilities, such as conceptualization, prediction, and anticipation of future are needed for the expression of anxiety. A few studies have investigated these preconditions cognitive variables (5). This perspective has important implications for better understanding the cognitive factors by which anxiety initiates and also could shed light on the conceptualization of anxiety in some neurodevelopmental disorders, including autism, characterized by deficits in cognitive ability and cognitive development. In this integrative literature review, using thematic analysis, we aimed to extract some cognitive abilities involved in anxiety development from the research that addressed the cognitive processes, cognitive models, and cognitive mechanisms in experiencing anxiety.

Materials & Methods

The integrative literature review was used to synthesize the literature. This method is considered as the best method for exploring the literature with diverse methodologies and approaches (18). Whittemore and Knafl’s (18) methodology for conducting integrative reviews contains five steps: formulation of the problem, literature search, evaluation of data, data analysis, and presentation of the results. Formulation of the problem is presented in the introduction section. The other steps are described below.

Literature search

A systematic search strategy was used to find the literature relevant to the subject of the study. Four databases (Scopus, OVID-PsycINFO, PubMed, ScienceDirect) were searched using search terms from 1900 to 2018, and a systematic search strategy was used to identify the literature related to the subject (See Table 1).
selected articles. In addition, an online search was conducted using Google to identify relevant grey literature (n=7). Titles and abstracts were screened, which resulted in the removal of 2,319 non-relevant articles; i.e., 51 studies remained for full-text review. Finally, 25 articles were found as eligible, based on the inclusion and exclusion criteria (see figure 1). The inclusion and exclusion criteria are presented in Table 2. Just the original and peer-reviewed papers were included in this study because the good-quality sources for a literature review are those that are peer-reviewed and original research (19). Two researchers screened titles and abstracts of papers in duplicate for inclusion, and disagreements were resolved through discussion. Full publications were then reviewed in duplicate for inclusion. Disagreements were resolved by a discussion between two reviewers.

**Analysis of data**

Data were analyzed using thematic analysis at both semantic or explicit and latent or interpretative levels (20); however, our approach to extracting themes from papers was more interpretative. Twenty-five articles were reviewed, and various themes and concepts were identified from the findings of these articles. Afterward, the main themes were extracted. For all stages of the study, all articles were analyzed by two reviewers independently; then, each reviewer presented her understanding and interpretations to the other one. Two reviewers collaborated closely until achieving an agreement about the main themes, which are presented in the next section.

**Results**

The results of the review are presented as themes, drawn from the findings of each article to address the overall literature. Aveyard (21) suggests a simplified method for thematic analysis of the literature. This method advises researchers to summarize the content of each paper. Then, the researcher should focus on the results section, re-read and describe the findings of each paper, and identify themes from the findings (21). First, we conducted a descriptive analysis of studies to extract general characteristics and relevant results (see Table 3). As mentioned earlier, our approach to identifying themes is inclined towards interpretative approaches. Although none of the articles directly mentioned cognitive abilities important to the development of anxiety, we extracted some cognitive abilities, including (1) Threat perception; (2) Future thinking; and (3) Generalization that explained below. Some of the studies contained more than one theme as well as a recurring theme.

**3.1 Content Validity**

To validate themes, fifteen experts were asked to rate the themes on two grounds: The first rating, called CVR (content validity rate), is defined as “essential, useful but not necessary, and not necessary”, and the second rating is content validity index (CVI) and is defined as “irrelevant, need serious review, relevant but need review, and fully relevant.” CVI is computed as the number of experts rating each theme as “strongly relevant” divided by the total number of experts. Values ranged from zero to 1, where CVI > 0.79 indicates the relevance of the item. The formula for computing the CVR is

\[
\text{CVR} = \frac{\text{Ne} - \frac{N}{2}}{\frac{N}{2}}
\]

where Ne is the number of experts rating an item as “essential” and N is the total number of experts (22)have made it an essential step in the instrument development. This article attempts to give an overview of the content validity process and to explain the complexity of this process by introducing an example.
We carried out a methodological study conducted to examine the content validity of the patient-centered communication instrument through a two-step process (development and judgment). Content validity will be approved if the value is greater than the value mentioned in the table (Table 4) (23). Based on the table, for each theme, CVR ≥0.49 indicates that the theme is essential. The scores obtained from CVR (necessity) and CVI (resolution) for each theme in this research are shown in Table 5. As you see in Table 5, all three themes gained the required quota in both CVR and CVI.

3.2. Inter-rater reliability

Initially, inter-rater reliability was tested by comparing the absence or presence of themes (See Table 6). Inter-rater reliability was calculated using the formula suggested by Miles & Huberman (24):

\[
\text{Reliability} = \frac{\text{number of agreements}}{\text{number of agreements} + \text{disagreements}}
\]

As a rule, the minimum percentage to indicate adequate levels of agreement is 75% (25). Values lower than this percentage demonstrate an inadequate level of agreement. According to this formula, the inter-rater reliability in this research is:

\[
\text{Reliability} = \frac{22}{22 + 1} = 0.95 \text{ High agreement}
\]

Hence, in this study, the thematic analysis presented adequate inter-rater reliability.

Themes

**Threat perception**

Research on cognition and cognitive process in childhood anxiety revealed some cognitive biases toward threats. Some papers mentioned specific types of cognitive biases involved in developing and maintaining childhood anxiety, including attentional bias to threat (26–31), threat interpretation bias (32–37), judgment bias of ability to deal with threatening/negative events (14,31,32), probability bias about occurring threatening events in future (38–41), threat perception and detection bias (15,42–44), memory bias to threat (27), and emotional reasoning (45). It can be concluded that if children can pay attention to threats, interpret threats from ambiguous stimuli and situations, perceive and detect a threat from stimuli, view physical symptoms as a sign of impending danger and threat (i.e., emotional reasoning), judge threatening events as more likely to occur (i.e., probability bias), recall more memories about the threat (i.e., memory bias), and underestimate their ability to cope with a threatening situation (i.e., judgment bias), they must be able to perceive the threat. Hence, we consider threat perception as an ability that is a prerequisite for experiencing anxiety.

**Future thinking**

Some articles revealed a bias relevant to future-directed thinking, called probability bias. As reported by a number of studies (38–40), anxious children estimated negative events as more likely to happen in the future. Using a future-thinking task, Miles et al. (41) reported that anxious children predicted more negative events in the future. As anxious children anticipate more negative events in the future, it can be argued that future thinking ability contributes to the development of anxiety, and perhaps some children that have deficits in future thinking are less likely to experience anxiety.

**Generalization**

Among 25 articles analyzed in this review, 4 mentioned the role of overgeneralization in the development of anxiety (32,46–48). Weems et al. (2001) and Cannon and Weems (32) reported overgeneralization as an important cognitive distortion in the pathology of anxiety. El-Bar
et al. (47) and Schiele et al. (46) addressed the role of fear generalization in childhood anxiety. Anxious children exhibited lower perceptual discrimination thresholds and wider generalization after conditioning. Thus, over-generalization is a feature of anxiety disorder, and it can be concluded that presumably, a person should have the ability of generalization to experience anxiety.

Table 1. Search terms

| Database searched | Search terms and strategies used |
|-------------------|----------------------------------|
| Scopus            | TITLE-ABS-KEY (cognition OR cognitive OR “Developmental factor” OR “Developmental marker”) AND TITLE (anxiety OR anxious) AND TITLE-ABS-KEY(youth OR “young people” OR “young person” OR adolescent OR teen OR juvenile OR children OR child) |
| PubMed            | (cognition[tiab] OR cognitive[tiab] OR “ Developmental factor”[tiab] OR “ Developmental marker”[tiab]) AND “anxiety”[ti] AND (youth[tiab] OR young people[tiab] OR “young person”[tiab] OR adolescent [tiab] young people[tiab] OR teen[tiab] OR juvenile[tiab] OR children[tiab] OR child[tiab]) |
| OVID-PsycINFO     | (cognition or cognitive or “Developmental factor” or Developmental marker).ab. and (youth or “young people” or “young person” or adolescent or teen or juvenile or children or child).ab. and anxiety.ti. |
| Sciencedirect     | Title: (anxiety) Title, abstract or keywords: (youth OR “young people” OR “young person” OR adolescent OR teen OR juvenile OR children OR child) AND (cognition OR cognitive OR “Developmental factor” OR “Developmental marker”) |

Table 2. Inclusion and exclusion criteria.

| Inclusion                                                                 | Rationale |
|---------------------------------------------------------------------------|-----------|
| 1. Literature mentioned the cognition, cognitive process, cognitive models, cognitive prerequisites and abilities, and cognitive developmental markers that play a role in experiencing anxiety. | to address the purpose of the study |
| 2. The study population included children, adolescents or both             | to address the purpose of the study |
| 3. Research published between 1900 and 2018                                | To attain a wider range of research |
| 4. Peer-reviewed research                                                  | To increases the vigor and credibility of the study. |
| 5. Primary or original research                                            | To include good-quality research only. |
| 6. Articles with full text available                                       | To be able to analyze the whole of the article |
| Exclusion                                                                 | Rationale |
| Non-English literature that has not been translated                       | It would take time and expense to translate papers written in a different language. |
| Literature addressed just the specific type of anxiety                     | The purpose of the study is to examine cognitive abilities involved in all kinds of anxiety disorders and overall anxiety. |
Table 3. Summary of the reviewed studies

| Author/s and years          | country          | Participants                                      | Anxiety measure                                              | Study Design       | Findings                                                                 |
|-----------------------------|------------------|---------------------------------------------------|---------------------------------------------------------------|--------------------|---------------------------------------------------------------------------|
| 1 Richards et al., 2007 (26)| United Kingdom   | 50 children aged 10 to 11 years                   | State-Trait Anxiety Inventory for Children                   | correlational      | High-anxious children sowed more selective attention to threat.           |
| 2 Muris, Kindt, et al., 2000 (42)| The Netherlands  | 105 children aged 8–13 years                      | State-Trait Anxiety Inventory for Children                   | correlational      | High levels of anxiety were associated with higher threat perception and detection. |
| 3 Muris and van der Heiden, 2006 (38) | The Netherlands | 70 primary school children aged 10–13 years      | Revised Child Anxiety and Depression Scale                   | comparative       | High-anxious children estimated future negative events as more likely to happen in future (higher ratings of probability bias) After controlling for comorbid depression symptoms, higher level anxiety were significantly accompanies by higher probability bias for future negative events. |
| 4 Muris, Merckelbach, et al., 2003 (15) | The Netherlands | 156 children aged 8–13 years                      | The Spence Children’s Anxiety Scale                          | comparative       | High levels of anxiety were associated with higher threat perception and detection |
| 5 Watts and Weems, 2006 (27)  | United States    | 81 participants aged 9-17 years                   | The Revised Child Anxiety and Depression scales              | correlational      | Attention bias and memory bias toward threat positively predict the high level of anxiety. |
| 6 Waters et al., 2014 (28)   | Australia        | 435 children aged 5-13 years (233 children with anxiety disorder 202 with no psychiatric disorder) | Spence Children’s Anxiety Scale                              | comparative       | Children with principal distress anxiety disorder (GAD) indicated a significant attention bias toward threat and children with principal fear disorder (social phobia, specific phobia, separation anxiety disorder) indicated a significant attention bias away from threat compared to healthy controls. |
### Table 3. Summary of the reviewed studies

| Author/s and years | Country | Participants | Anxiety measure | Study Design | Findings |
|--------------------|---------|--------------|----------------|--------------|----------|
| Cannon and Weems, 2010 | United States | 72 children and adolescents aged 7-17 years (24 clinically anxious participants and 48 healthy matched controls) | The Revised Child Anxiety and Depression scale | Comparative correlational | Anxious children showed lowered estimates of the ability to control external and/or internal threatening stimuli (judgment biases) and more tendency to interpret neutral stimuli in a threatening way (interpretive biases) compared to healthy controls. Also overgeneralization and judgement bias were significantly predictors of anxiety. |
| Muris, Luermans, et al., 2000 | The Netherlands | 45 children and adolescents aged 9-17 years | The Netherlands | State-Trait Anxiety Inventory for Children | High levels of anxiety were associated with higher threat perception and detection. |
| Bögels and Zigterman, 2000 | The Netherlands | 15 anxious children and adolescents, 15 children with externalizing disorder, 15 healthy controls matched the anxious children | Diagnostic Interview Schedule for Children | Comparative | Anxious children judged given stories as more dangerous and had lowered estimates of their ability to cope with threats compared to control groups. |
| Morren et al., 2008 | The Netherlands | 122 children aged 7-13 years | The Revised Children’s Anxiety and Depression Scale | Correlational | The emotional reasoning (tend to employ specific interpretive information as a parameter for determining the dangerousness of a situation) positively predicted the level of anxiety. |
| Author/s and years | country | Participants | Anxiety measure | Study Design | Findings |
|-------------------|---------|--------------|----------------|-------------|----------|
| 11 Creswell et al., 2011 (33) | United Kingdom | 110 children aged 5-9 years | Child Behavior Checklist Scale | longitudinal correlational | Interpretation of ambiguity as threatening were stable over time and significantly predicted anxiety in children. |
| 12 Creswell and O'Connor, 2011 (34) | United Kingdom | 65 children aged 10-11 years | Spence Children’s Anxiety Scale | - longitudinal - correlational | Individual differences in threat interpretation of ambiguity were stable over time and were significantly associated with anxiety symptoms. |
| 13 Waters, Craske, et al., 2008 (35) | Australia | 45 children aged 7-12 years (15 anxious children 14 non-anxious control children 16 at-risk children) | The Anxiety Disorders Interview Schedule for Children | - comparative | anxious children showed more interpretation biases and reported less ability to cope with threatening situations compared with control and at-risk groups. |
| 14 Miles et al., 2004 (41) | United Kingdom | 123 school-aged adolescents | Revised Children’s Manifest Anxiety Scale | comparative - correlational | In future thinking task, anxious children predicted more negative events in future and in memory task, they reported more negative events in the past. |
| 15 Muris, Rapee, et al. 2003 (80) | The Netherlands | 299 children aged 8-13 years | The Spence Children’s Anxiety Scale | - correlational | High level of general anxiety and state anxiety were significantly relates to lower threat thresholds and increased threat perception. |
| 16 Schiele et al., 2016 (46) | Germany | 267 Children aged 8-10 and 285 adults aged 18-50 | Skin conductance responses (SCR) and ratings of valence and arousal | experimental | Children indicated higher fear generalization relative to adults. Also results showed that overgeneralization of conditioned fear is a developmental correlate of fear learning that is the pathogenesis of anxiety disorder. |
| Author/s and years | country          | Participants                                                                 | Anxiety measure                                      | Study Design   | Findings                                                                                                                                 |
|-------------------|------------------|-------------------------------------------------------------------------------|-----------------------------------------------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------|
| 17 El-Bar et al., | Israel           | 40 children and adolescents 9-18 years (17 anxious children and adolescents., | Diagnostic Interview Schedule for Children          | experimental  | Anxious children showed overgeneralization and lowered perceptual discrimination thresholds compared to healthy control.                |
| 2017 (47)         |                  | 23 age-matched control)                                                      |                                                     |                |                                                                                                                                        |
| 18 Roy et al., 2008 | United States    | 101 children and adolescents aged 7-18 years (51 Non-anxious youths aged 9 - 18 years) | Anxiety Disorder Interview Schedule for Children    | comparative    | Anxious children showed a greater attention bias toward threat compared to control group.                                             |
| (29)              |                  |                                                                              |                                                     |                |                                                                                                                                        |
| 19 Creswell et al., | Australia        | 60 children aged 7-15 years (27 children with anxiety disorders, 33 nonclinical Children) | Revised Children’s Manifest Anxiety Scale           | comparative    | Compared to healthy control, anxious children interpret ambiguous situation as more threatening.                                      |
| 2005 (37)         |                  |                                                                              |                                                     |                |                                                                                                                                        |
| 20 Vasey et al., 1995 | United States    | 24 children aged 9-14 years (12 anxious children., 12 normal controls)        | Child Behavior Checklist                             | comparative    | The anxious children showed attentional bias toward threat words compared to non-anxious children.                                     |
| (30)              |                  |                                                                              |                                                     |                |                                                                                                                                        |
| 21 Weems et al., 2001 | United States    | 251 anxious children and adolescents aged 6-17 years                          | Revised Children’s Manifest Anxiety Scale           | correlational  | After controlling depression score, overgeneralization significantly related to anxiety trait, anxiety sensitivity and manifest anxiety. overgeneralization was the strongest predictor of trait anxiety. |
| Author/s and years | country       | Participants                                                                 | Anxiety measure                        | Study Design               | Findings                                                                                                                                                                                                                                                                                                                                 |
|-------------------|---------------|-------------------------------------------------------------------------------|----------------------------------------|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 22 Waters, Wharton et al., 2008 (31) | Australia     | 38 children aged 8-12 years (19 anxious children., 19 non-anxious control children) | Spence Children’s Anxiety Scale        | comparative correlational | Anxious children showed significantly higher interpretation and attention biases towards threat at pre-treatment in compared with healthy children. After successful treatment with CBT, interpretation biases toward threat but not attentional biases toward threat reduced in anxious children. For anxious group at pre and post- treatment the levels of anxiety were significantly associated with higher danger judgments and negative emotions. |
| 23 Dalgleish et al., 1997 (39)          | United Kingdom | 80 children and adolescents 9-18 years (15 depressed children and adolescents., 22 anxious children and adolescents., 43 healthy control) | Revised Children’s Manifest Anxiety Scale | comparative correlational | The anxious children and controls estimated that negative events were more likely to happen in the future to others than to themselves and this effect was stronger in the anxious group.                                                                                                                   |
| 24 Canterbury et al., 2004 (40)        | United Kingdom | 66 participants aged 9-18 years                                              | The Revised Children’s Manifest Anxiety Scale | comparative correlational | The high anxious participants estimated negative events as more likely to happen in the future than the low anxious group. Probability estimates for negative events in the future increased with the levels of anxiety in all participants.                                                                                     |
| 25 Taghavi et al., 2000 (36)            | United Kingdom | 57 children and adolescents aged 8-17 years (17 anxious patients., 40 healthy controls) | The Revised Children’s Manifest Anxiety Scale | comparative               | Clinically anxious children and adolescents reported the threatening meaning of ambiguous threat/neutral homograph words more relative to healthy control group in a sentence generation task.                                                                                      |
Table 4. CVR validity

| Number of people in expert panel | Minimum validity |
|----------------------------------|------------------|
| 5                                | 0.99             |
| 6                                | 0.99             |
| 7                                | 0.99             |
| 8                                | 0.85             |
| 9                                | 0.78             |
| 10                               | 0.62             |
| 15                               | 0.49             |
| 20                               | 0.42             |
| 25                               | 0.37             |
| 30                               | 0.33             |
| 40                               | 0.29             |

Table 5. CVR and CVI scores

| themes                 | CVR | CVI  |
|------------------------|-----|------|
| Threat perception      | 1   | 1    |
| Future thinking        | 0.73| 0.86 |
| generalization         | 0.6 | 0.8  |

Table 6. absence/presence themes

| Themes                           | In paper:                                      | Rater 1 Present/Absent | Rater 2 Present/Absent |
|----------------------------------|-----------------------------------------------|------------------------|------------------------|
| Threat perception                 |                                               |                        |                        |
| Vasey et al., 1995                | Present                                       | Present                | Present                |
| Dalgleish et al., 1997            | Present                                       | Present                | Present                |
| Bögels and Zigterman, 2000        | Present                                       | Present                | Present                |
| Muris, Kindt, et al., 2000        | Present                                       | Present                | Present                |
| Muris, Luermans, et al., 2000      | Present                                       | Present                | Present                |
| these stories contained information that could be interpreted as threatening | Present                                       | Present                | Present                |
| Taghavi et al., 2000              | Present                                       | Present                | Present                |
| Muris, Rapee, et al. 2003          | Present                                       | Present                | Present                |
| Muris, Merckelbach, et al., 2003   | Present                                       | Present                | Present                |
| Creswell et al., 2005             | Present                                       | Present                | Present                |
| Muris and van der Heiden, 2006    | Present                                       | Present                | Present                |
| Watts and Weems, 2006             | Present                                       | Present                | Present                |
Cognitive Prerequisites in Development of Childhood Anxiety: An Integrative Literature Review and Thematic Analysis

| Themes          | In paper:                        | Rater 1 Present/Absent | Rater 2 Present/Absent |
|-----------------|----------------------------------|------------------------|------------------------|
| Threat perception | Richards et al., 2007            | Present                | Present                |
|                 | Morren et al., 2008              | Present                | absent                 |
|                 | Roy et al., 2008                 | Present                | Present                |
|                 | Waters, Craske, et al., 2008     | Present                | Present                |
|                 | Waters, Wharton et al., 2008     | Present                | Present                |
|                 | Cannon and Weems, 2010           | Present                | Present                |
|                 | Creswell et al., 2011            | Present                | Present                |
|                 | Creswell and O’Connor, 2011      | Present                | Present                |
|                 | Waters et al., 2014              | Present                | Present                |
| Future thinking | Dalgleish et al., 1997           | Present                | Present                |
|                 | Miles et al., 2004               | Present                | Present                |
|                 | Canterbury et al., 2004          | Present                | Present                |
|                 | Muris and van der Heiden, 2006   | Present                | Present                |
| Generalization  | Weems et al., 2001               | Present                | Present                |
|                 | Cannon and Weems, 2010           | Present                | Present                |
|                 | Schiele et al., 2016             | Present                | Present                |
|                 | El-Bar et al., 2017              | Present                | Present                |

Discussion

In this review, we explored some cognitive abilities that are likely important to experience anxiety by analyzing written documents about the cognitive processes in childhood anxiety. The findings indicated three cognitive abilities (i.e., threat perception, future thinking, and generalization). The ability of threat perception is one of the identified abilities. Perception of threat is a major component of various definitions and theories of anxiety. According to the American Psychiatric Association (49), anxiety is anticipation of future threats that more often are associated with muscle tension and vigilance in preparation for future danger and cautious or avoidant behavior. Threat perception is considered an adaptive process that helps the individuals adjust to the environment (50); However, threat perception is not always an adaptive process.

According to Beck’s theory of anxiety, anxious individuals tend to overestimate the threat and perceive more threats in different situations (51). In general, the tendency to process situations as threatening is a central feature of cognitive models of anxiety (e.g., 51–53). The earliest signs of threat detection emerge in infancy around the age of 3–4 months and are present throughout childhood (54). As threat detection and perception is a central
feature of anxiety, it seems that anxious children should have the ability of threat perception to experience anxiety. Anxiety is a future-oriented emotional state, and all humans experience it to varying degrees. Anticipating or pre-viewing the future evokes anxiety, and this emotion is relevant to anticipatory representations of future events (55). According to Beck’s cognitive theory, anxiety includes a large future-directed component as it is viewed primarily as involving the anticipation of potential future threats (see, e.g., 51). Developmental studies showed that children begin to develop the ability to think and anticipate the future around the age of three (56), and by five or six years of age, this ability is still improving (57,58). One facet of future thinking is episodic future thinking which allows individuals to pre-experience the future (56,59). Episodic future thinking is defined as the ability to project oneself into the future and pre-experience an event in the future (59). Anxious individuals exhibit a pessimistic bias toward the future, pre-experience threatening in the near and far future (60), and anticipate the occurrence of threatening events in the future (61,62). As anxiety contains a future-directed component, it is likely necessary for children to have future thinking abilities in order to experience anxiety. Accordingly, children who have deficits in future thinking are less likely to experience anxiety.

Based on the results of this review, another cognitive ability involved in anxiety is generalization. Some articles analyzed in this review mentioned overgeneralization as a mechanism that occurs in anxious individuals (e.g., (47,63–65). Also, In cognitive and learning theories, overgeneralization of dangerous stimuli is considered an etiological account of anxiety (66). According to learning theory, stimulus generalization is a learning mechanism by which a response previously trained for a specific stimulus can also be elicited by another similar, but not identical, stimuli (67); Accordingly, when the stimulus predicts negative or dangerous outcomes, other similar stimuli can elicit the danger and threat as well (68). Although generalization of fear learning is an adaptive mechanism for survival, wide generalization can cause some problems in life (69–71), including anxiety (Laufer et al., 2016). Overgeneralization can happen in the form of broad generalization for threatening or dangerous stimulus that have an imprecise similarity or association with a learned threat and causes clinical anxiety (72–74); Indeed, fear generalization is a characteristic of anxiety disorders such that the focus of fear becomes excessive and broad, extending to many objects, persons, and situations (49,74). Yet, even in a safe context, patients still have wide generalization (66). Additionally, cognitive models of psychopathology emphasize the role of faulty or negative ways of thinking in anxiety (75,76). Beck’s cognitive model introduced some cognitive distortions or errors and assigned an important role in clinical anxiety to them (75). One of these cognitive distortions is overgeneralization. It happens when one supposes that the negative outcome of an event applies to the same or similar event or situation in the future (77). Research indicated that this cognitive error was a strong predictor of anxiety in children (48,78). As a result, it is assumed that the ability of generalization can play an important role in experiencing anxiety. This review suggests that children with poor performance in generalization ability are less likely to experience anxiety.

While we tried to use a rigorous and systematic method to conduct this review, some limitations

Iran J Child Neurol. Summer 2022 Vol. 16 No. 3
should be acknowledged. Owning to resource constraints, our search was limited to published literature that were written in English and indexed in investigated databases.

Conclusions and Future directions
The role of cognitive development and cognitive abilities in childhood anxiety is asserted by several researchers (e.g., 13,79). The current study was a further attempt to investigate the cognitive abilities prerequisite to experience anxiety in children. We explored the literature surrounding the cognitive process in anxiety, and three cognitive abilities that may underlie anxiety were extracted (i.e., threat perception, generalization, and future thinking). This integrative literature review makes an important contribution to current understandings of the anxiety phenomena in children. This study also could have implications for understanding anxiety in children who suffer from some neurodevelopmental disorders, including autism, which can cause impairment in mentioned cognitive abilities. Hence, diagnosing anxiety in these children requires special considerations and careful monitoring. Nevertheless, further studies (e.g., experimental studies) are required to extend our knowledge regarding this topic. Also, other cognitive abilities involved in the development of childhood anxiety can be an interesting topic. Some comparative studies in which anxiety of children with cognitive deficits is compared to that of their typically developing counterparts would provide more detailed information about the role of cognitive development and cognitive abilities on the development of anxiety.

Acknowledgment
We are thankful to the Center of Excellence in Cognitive Neuropsychology, Institute for Cognitive and Brain Sciences, Shahid Beheshti University, Tehran, Iran.

Author’s Contribution
Samaneh Behzadpoor: substantial contributions to conception and design, acquisition of data, and writing the manuscript. Hamidreza Pouretemad: contributions to conception and design, participated in revising, and gave final approval of the version to be submitted. Saeid Akbari Zardkhaneh: contributed to writing the manuscript, participated in revising and gave final approval of the version.

Conflict of interest
None

References
1. Polanczyk G V., Salum GA, Sugaya LS, Caye A, Rohde LA. Annual Research Review: A meta-analysis of the worldwide prevalence of mental disorders in children and adolescents. J Child Psychol Psychiatry 2015;56(3):345–65.
2. Case R, Hayward S, Lewis M, Hurst P. Toward a neo-Piagetian theory of cognitive and emotional development. Dev Rev. 1988;8(1):1–51.
3. Fischer KW, Shaver PR, Carnochan P. A skill approach to emotional development: From basic- to subordinate-category emotions. In: W. Damon, editor. The Jossey-Bass social and behavioral science series Child development today and tomorrow. San Francisco, CA, US: Jossey-Bass; 1989. p. 107–36.
4. Vancu G. Anxiety of children with intellectual disability. Agora Psycho-Pragmatica. 2018;12(1):107–14.
5. Broeren S, Muris P. The Relation Between Cognitive Development and Anxiety Phenomena in Children. J Child Fam Stud. 2009;18(6):702–9.

6. Muris P, Merckelbach H, Luijten M. The connection between cognitive development and specific fears and worries in normal children and children with below-average intellectual abilities: a preliminary study. Behav Res Ther. 2002;40(1):37–56.

7. Karpinski RI, Kinase Kolb AM, Tetreault NA, Borowski TB. High intelligence: A risk factor for psychological and physiological overexcitabilities. Intelligence. 2018;66:8–23.

8. Penney AM, Miedema VC, Mazmanian D. Intelligence and emotional disorders: Is the worrying and ruminating mind a more intelligent mind? Pers Individ Dif. 2015;74:90–3.

9. Kertz SJ, Bigda-Peyton JS, Rosmarin DH, Björgvinsson T. The importance of worry across diagnostic presentations: Prevalence, severity and associated symptoms in a partial hospital setting. J Anxiety Disord. 2012;26(1):126–33.

10. Rabner J, Mian ND, Langer DA, Comer JS, Pincus D. The Relationship Between Worry and Dimensions of Anxiety Symptoms in Children and Adolescents. Behav Cogn Psychother. 2017;45(2):124–38.

11. Rieske RD, Matson JL, Davis TE. The Moderating Effect of Autism Symptomatology on Anxiety Symptoms. J Dev Phys Disabil. 2013;25(5):517–31.

12. Mayes SD, Calhoun SL, Murray MJ, Zahid J. Variables Associated with Anxiety and Depression in Children with Autism. J Dev Phys Disabil. 2011;23(4):325–37.

13. Vasey MW. Development and cognition in childhood anxiety: The example of worry. - PsycNET. Adv Clin Child Psychol. 1993;15:1–39. A

14. Bögels SM, Zigterman D. Dysfunctional cognitions in children with social phobia, separation anxiety disorder, and generalized anxiety disorder. J Abnorm Child Psychol. 2000;28(2):205–11.

15. Muris P, Merckelbach H, Schepers S, Meesters C. Anxiety, Threat Perception Abnormalities, and Emotional Reasoning in Nonclinical Dutch Children. J Clin Child Adolesc Psychol. 2003;32(3):453–9.

16. Atance CM, Hanson LK. Making predictions: a developmental perspective. In: Bar M, editor. Predictions in the brain: using our past to generate a future. New York, NY, US: Oxford University Press; 2011. p. 311–25.

17. Flavell JH, Miller PH, Miller SA. Cognitive development. 4th ed. New-Jersey: Prentice Hall; 2002. 423 p.

18. Whittemore R, Knafl K. The integrative review: updated methodology. J Adv Nurs. 2005;52(5):546–53.

19. Plano Clark VL, Creswell JW. Understanding research: a consumer’s guide. Upper Saddle River, NJ: Merrill/Pearson Educational; 2010. 388 p.

20. Braun V, Clarke V. Using thematic analysis in psychology. Qual Res Psychol. 2006;3(2):77–101.

21. Aveyard H. Doing a literature review in health and social care: a practical guide. 3rd ed. London: Open University Press; 2014.

22. Zamanzadeh V, Ghahramanian A, Rassouli M, Abbaszadeh A, Alavi-Majd H, Nikanfar A-R. Design and Implementation Content Validity Study: Development of an instrument for measuring Patient-Centered Communication. J
Cognitive Prerequisites in Development of Childhood Anxiety: An Integrative Literature Review and Thematic Analysis.

23. Lawshe CH. A quantitative approach to content validity. Pers Psychol. 1975;28(4):563–75.
24. Miles M.B & Huberman A. An expanded sourcebook: Qualitative data analysis (2nd Edition). London: SAGE Publications; 1994. 1–354 p.
25. Saldaña J. The Coding Manual for Qualitative Researchers. Sage. London: SAGE Publications Ltd; 2016.
26. Richards A, French CC, Nash G, Hadwin JA, Donnelly N. A comparison of selective attention and facial processing biases in typically developing children who are high and low in self-reported trait anxiety. Development and Psychopathology. 2007;19(2):481-95.
27. Watts SE, Weems CF. Associations Among Selective Attention, Memory Bias, Cognitive Errors and Symptoms of Anxiety in Youth. J Abnorm Child Psychol. 2006;34(6):838–49.
28. Waters AM, Bradley BP, Mogg K. Biased attention to threat in paediatric anxiety disorders (generalized anxiety disorder, social phobia, specific phobia, separation anxiety disorder) as a function of ‘distress’ versus ‘fear’ diagnostic categorization. Psychol Med. 2014;44(3):607–16.
29. Roy AK, Vasa RA, Bruck M, Mogg K, Bradley BP, Sweeney M, et al. Attention Bias Toward Threat in Pediatric Anxiety Disorders. J Am Acad Child Adolesc Psychiatry. 2008;47(10):1189–96.
30. Vasey MW, Daleiden EL, Williams LL, Brown LM. Biased attention in childhood anxiety disorders: a preliminary study. J Abnorm Child Psychol. 1995 ;23(2):267–79.
31. Waters AM, Wharton TA, Zimmer-Gembeck MJ, Craske MG. Threat-based cognitive biases in anxious children: Comparison with non-anxious children before and after cognitive behavioural treatment. Behav Res Ther. 2008;46(3):358–74.
32. Cannon MF, Weems CF. Cognitive biases in childhood anxiety disorders: do interpretive and judgment biases distinguish anxious youth from their non-anxious peers? J Anxiety Disorders. 2010;24(7):751–8.
33. Creswell C, Shildrick S, Field AP. Interpretation of Ambiguity in Children: A Prospective Study of Associations With Anxiety and Parental Interpretations. J Child Fam Stud. 2011;20(2):240–50.
34. Creswell C, O’Connor TG. Interpretation Bias and Anxiety in Childhood: Stability, Specificity and Longitudinal Associations. Behav Cogn Psychother. 2011;39(2):191–204.
35. Waters AM, Craske MG, Bergman RL, Treanor M. Threat interpretation bias as a vulnerability factor in childhood anxiety disorders. Behav Res Ther. 2008;46(1):39–47.
36. Taghavi MR, Moradi AR, Neshat-Doost HT, Yule W, Dalgleish T. Interpretation of ambiguous emotional information in clinically anxious children and adolescents. Cogn Emot. 2000;14(6):809–22.
37. Creswell C, Schniering CA, Rapee RM. Threat interpretation in anxious children and their mothers: comparison with nonclinical children and the effects of treatment. Behav Res Ther. 2005;43(10):1375–81.
38. Muris P, van der Heiden S. Anxiety, depression, and judgments about the probability of future negative and positive events in children. J Anxiety Disord. 2006;20(2):252–61.
39. Dalgleish T, Taghavi R, Neshat-Doost H, Moradi A, Yule W, Canterbury R. Information
Processing in Clinically Depressed and Anxious Children and Adolescents. J Child Psychol Psychiatry. 1997;38(5):535–41.

40. Canterbury R, Golden A-M, Taghavi R, Neshat-Doost H, Moradi A, Yule W. Anxiety and judgements about emotional events in children and adolescents. Pers Individ Dif. 2004;36(3):695–704.

41. Miles H, MacLeod AK, Pote H. Retrospective and prospective cognitions in adolescents: anxiety, depression, and positive and negative affect. J Adolesc. 2004;27(6):691–701.

42. Muris P, Kindt M, Bögels S, Merckelbach H, Gadet B, Moulaert V. Anxiety and Threat Perception Abnormalities in Normal Children. J Psychopathol Behav Assess. 2000;22(2):183–99.

43. Muris P, Luermans J, Merckelbach H, Mayer B. "Danger is lurking everywhere": the relation between anxiety and threat perception abnormalities in normal children. J Behav Ther Exp Psychiatry. 2000;31(2):123–36.

44. Essau C, Ollendick TH. The Wiley-Blackwell handbook of the treatment of childhood and adolescent anxiety. Wiley; 2013.

45. Morren M, Muris P, Kindt M, Schouten E, van Hout M. Emotional Reasoning and Parent-Based Reasoning in Non-Clinical Children, and Their Prospective Relationships with Anxiety Symptoms. Child Psychiatry Hum Dev. 2008;39(4):351–67.

46. Schiele MA, Reinhard J, Reif A, Domschke K, Romanos M, Deckert J, et al. Developmental aspects of fear: Comparing the acquisition and generalization of conditioned fear in children and adults. Dev Psychobiol. 2016;58(4):471–81.

47. El-Bar N, Laufer O, Yoran-Hegesh R, Paz R. Over-generalization in youth with anxiety disorders. Soc Neurosci. 2017;12(1):76–85.

48. Weems F, Berman SL, Silverman WK, Saavedra LM. Cognitive Errors in Youth with Anxiety Disorders: The Linkages Between Negative Cognitive Errors and Anxious Symptoms. Cognit Ther Res. 2001;25(5):559–75.

49. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. fifth. Washington, DC, USA: American Psychiatric Association; 2013

50. Muris P, Meesters C, Smulders L, Mayer B. Threat perception distortions and psychopathological symptoms in typically developing children. Infant Child Dev. 2005;14(3):273–85.

51. Beck AT, Emery G, Greenberg RL. Anxiety disorders and phobias: A cognitive perspective. - PsycNET. New York, NY, US: Basic Books; 2005

52. Kendall PC. Toward a cognitive-behavioral model of child psychopathology and a critique of related interventions. J Abnorm Child Psychol. 1985;13(3):357–72.

53. Rapee RM. The Development of Generalized Anxiety. In: M. W. Vasey., M. R. Dadds, editors. The Developmental Psychopathology of Anxiety. New York, NY, US: Oxford University Press; 2001

54. Miller LE. Perceived Threat in Childhood. Trauma, Violence, Abus. 2015;16(2):153–68.

55. Grupe DW, Nitschke JB. Uncertainty and anticipation in anxiety: an integrated neurobiological and psychological perspective. Nat Rev Neurosci. 2013;14(7):488–501.

56. Atance CM, O’Neill DK. The emergence of episodic future thinking in humans. Learn Motiv. 2005;36(2):126–44.

57. Atance CM, Meltzoff AN. My future self:
Young children’s ability to anticipate and explain future states. Cogn Dev. 2005;20:341–61.

58. Quon E, Atance CM. A Comparison of Preschoolers’ Memory, Knowledge, and Anticipation of Events. J Cogn Dev. 2010;11(1):37–60.

59. Atance CM, O’Neill DK. Episodic future thinking. Trends Cogn Sci. 2001;5(12):533–9.

60. Hoerger M, Quirk SW, Chapman BP, Duberstein PR. Affective forecasting and self-rated symptoms of depression, anxiety, and hypomania: Evidence for a dysphoric forecasting bias. Cogn Emot. 2012;26(6):1098–106.

61. Miranda R, Mennin DS. Depression, Generalized Anxiety Disorder, and Certainty in Pessimistic Predictions about the Future. Cogn Ther Res. 2007;31(1):71–82.

62. Martin SM, Quirk SW. Social anxiety and the accuracy of predicted affect. Cogn Emot. 2015;29(1):51–63.

63. Daleiden EL, Vasey MW. An information-processing perspective on childhood anxiety. Clin Psychol Rev. 1997;17(4):407–29.

64. Ehrenreich JT, Gross AM. Biased attentional behavior in childhood anxiety. A review of theory and current empirical investigation. Clin Psychol Rev. 2002;22(7):991–1008.

65. Weems CF, Watts SE. Cognitive models of childhood anxiety. In: C. M. Velotis, editor. Anxiety Disorder Research. Hauppauge, NY, US: Nova Science Publishers; 2005. p. 205–32.

66. Laufer O, Israeli D, Paz R. Behavioral and Neural Mechanisms of Overgeneralization in Anxiety. Curr Biol. 2016;26(6):713–22.

67. Guttman N, Kalish HI. Discriminability and stimulus generalization. J Exp Psychol. 1956;51(1):79–88.

68. Schechtman E, Laufer O, Paz R. Negative Valence Widens Generalization of Learning. J Neurosci. 2010;30(31):10460–4.

69. Dunsmoor JE, Paz R. Fear Generalization and Anxiety: Behavioral and Neural Mechanisms. Biol Psychiatry. 2015;78(5):336–43.

70. Asok A, Kandel ER, Rayman JB. The Neurobiology of Fear Generalization. Front Behav Neurosci. 2018;12:329.

71. Dunsmoor JE, Otto AR, Phelps EA. Stress promotes generalization of older but not recent threat memories. Proc Natl Acad Sci U S A. 2017;34(114):9218–23.

72. Pitman RK, Rasmusson AM, Koenen KC, Shin LM, Orr SP, Gilbertson MW, et al. Biological studies of post-traumatic stress disorder. Nat Rev Neurosci. 2012;13(11):769–87.

73. Jovanovic T, Ressler KJ. How the Neurocircuitry and Genetics of Fear Inhibition May Inform Our Understanding of PTSD. Am J Psychiatry. 2010;167(6):648–62.

74. Lissek S. Toward an account of clinical anxiety predicated on basic, neurally mapped mechanisms of Pavlovian fear-learning: the case for conditioned overgeneralization. Depress Anxiety. 2012;29(4):257–63.

75. Beck AT, Emery G, Greenberg RL. Anxiety disorders and phobias : a cognitive perspective. 15th ed. New York: Basic Books; 2005. 343 p.

76. Ellis A. Reason and emotion in psychotherapy.. Oxford, England: Lyle Stuart.; 1962.

77. Pereira AIF, Barros L, Mendonça D. Cognitive errors and anxiety in school aged children. Psicologia. 2012;25(4):817–23.

78. Marie M, Heyne DA, van Widenfelt BM, Westenberg PM. Distorted Cognitive Processing in Youth: The Structure of Negative Cognitive
Errors and Their Associations with Anxiety. Cognit Ther Res. 2011;35(1):11–20.
79. Muris P, Mayer B, Vermeulen L, Hiemstra H. Theory-of-mind, cognitive development, and children’s interpretation of anxiety-related physical symptoms. Behav Res Ther. 2007;45(9):2121–32.
80. Muris P, Rapee R, Meesters C, Schouten E, Geers M. Threat perception abnormalities in children: the role of anxiety disorders symptoms, chronic anxiety, and state anxiety. J Anxiety Disord. 2003;17(3):271–87.