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Biobehavioral assessment of the anxiety disorders: Current progress and future directions

Deah Abbott, Yasmin Shirali, J Kyle Haws, Caleb W Lack

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Abstract

It is difficult to accurately assess and differentially diagnose the anxiety disorders. The current system of assessment relies heavily on the subjective measures of client self-report, clinical observation, and clinical judgment. Fortunately, recent technological advances may enable practitioners to utilize objective, biobehavioral

measures of assessment in a clinical setting. The current body of literature on two of these biobehavioral tools (eye-tracking and electrocardiogram devices) is promising, but more validation and standardization research is needed to maximize the utility of these devices. Eye-tracking devices are uniquely capable of providing data that can be used to differentially diagnose anxiety disorders from both other commonly comorbid and misdiagnosed disorders. Both eye-tracking and electrocardiogram devices are able to provide change-sensitive assessment information. This objective, real-time feedback can assist clinicians and researchers in assessing treatment efficacy and symptom fluctuation. Recently developed wearable and highly portable electrocardiogram devices, like the wearable fitness and behavior tracking devices used by many consumers, may be particularly suited for providing this feedback to clinicians. Utilizing these biobehavioral devices would supply an objective, dimensional component to the current categorical diagnostic assessment system. We posit that if adequate funding and attention are directed at this area of research, it could revolutionize diagnostic and on-going assessment practices and, in doing so, bring the field of diagnosis out of the 20th century.

Key words: Biobehavioral; Assessment; Diagnosis; Anxiety; Electrocardiogram; Electrocardiogram; Eye-tracker

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Core tip: Anxiety disorders are some of the most commonly comorbidly- and mis-diagnosed disorders in the DSM-5. The current system of assessment and diagnosis depends on clinician and client report measures, which are subjective and prone to bias. Recent technological advances make it possible to utilize the biobehavioral measures from eye-tracking and electrocardiogram devices in clinical settings. These devices can provide a much needed dimensional, objective, and change-sensitive component to current diagnostic and treatment-efficacy assessment protocols. This article summarizes the

status of and outlines future directions for research on this important topic.

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INTRODUCTION

While the Diagnostic and Statistical Manual of Mental Disorders (DSM) has been the guidebook to the assessment for psychiatric disorders for more than half of a century, its system of diagnosis has been fraught with flaws, concerns, and issues since its inception. Each revision of the DSM has sought to correct the flaws of the preceding revision, resulting in so many changes that the first edition of the text bears little resemblance to the most recent edition, the DSM-5^[1]. Each of these editions have been built on the same principle: Developing a system of discrete categorical diagnoses which are determined by a list of symptom criteria—the presence or absence of which are determined by tools of client self-report, clinical observation, and clinical judgment^[2]. Once a diagnosis is determined, those three tools are used in the ongoing assessment of symptom severity to determine treatment efficacy. Despite the advances made over the past several decades, there are still serious problems with this current system of assessment. Excitingly, recent technological advances and research breakthroughs in biobehavioral tools of assessment may help address these issues to build a sounder system of diagnosis and a sensitive system for assessing the fluctuation of symptom severity, particularly in the realm of anxiety.

The DSM-5's categorical system presumes that mental disorders are discrete issues with distinct boundaries^[1], however this concept is not reflected in the research^[3]. For people with anxiety disorders having comorbid disorders may be more common than having a single, discrete disorder. For example, one study found that 89% of people with an anxiety disorder were also diagnosed with a disorder of a different category^[4]. One reason for this is that there is considerable overlap in the diagnostic criteria between some of the anxiety disorders and other categories, such as the depressive disorders^[5]. While many people who are diagnosed with dual or multiple disorders may truly have two (or more) discrete disorders, a dual diagnosis in some people can instead be due to a single underlying issue that presents in such a way to cause a dual diagnosis with the current nosology^[6]. A separate study indicated that approximately one third of participants with at least one anxiety disorder diagnosis also qualified for at least one or more additional anxiety disorder diagnosis^[7]. Comorbidity in anxiety disorders

is associated with difficulties in determining treatment path^[8] and worsened clinical outcomes related to course of treatment^[9].

While the DSM-5 was being developed, the task force considered adopting a dimensional model of psychopathology, in contrast to the current categorical system^[2,10,11]. The dimensional model looks at disorders as not having a single distinct cut off point, and allows for multiple dimensions in a diagnostic model, such as intensity, duration, and level of disruption caused by a disorder's symptoms and components^[10]. Most advocates for this system suggested the integration of a dimensional component into the categorical system to provide a fuller diagnostic picture that would be more functional for clinical application^[2,12]. Some sections of the DSM-5 diagnostic structure included a quasi-dimensional element, by including specifiers that categorize severity of symptoms as "Mild", "Moderate", or "Severe"^[1]. Unfortunately, the dimensional model was not incorporated into the DSM-5 diagnostic structure for anxiety disorders in any way, shape, or form^[1]. Since its publication, the debate has continued as to whether the DSM's categorical model should continue to be revised to a more dimensional structure^[13].

One reason the dimensional model was not incorporated into the DSM-5 was the lack of a single, standard, empirically-supported, and widely-agreed upon measurement of assessment for the dimensional system for the anxiety disorders to be based upon^[10]. This issue may be tied to another problem in the current system of assessment for anxiety disorders: Dependence on accurate self-reports by the client and accurate clinical observation and judgment. Reflecting this, there was disagreement about whether a dimensional scale would rely primarily on clinician ratings or client self-ratings^[10]. Both sources of information are subjective, of course, and thus highly flawed. As but one example, client self-report and clinician-report on psychological measures do not necessarily agree with one another^[14]. Accurate self-report requires high levels of insight and complete honesty on the part of the client. Many clients cannot or will not accurately perceive their thoughts and feelings or the reasonableness of those thoughts. This is widely understood, as evidenced by the DSM-5's addition of a level of client insight specifier for disorders like obsessive compulsive disorder (OCD)^[11]. Even if clients do have a clear understanding of their symptomatology, one study found that 93% of clients purposely lie to their mental health practitioners, with the most frequent lies being about the severity of the symptoms and how badly the client feels^[15]. Additionally, there is considerable error in self-reporting for observable behaviors such as physical activity^[16], so even the reports of clients trying to be accurate with fair insight into their psychological state may be inaccurate due to biases and memory errors.

Similarly, clinical judgment is also prone to errors and biases. Clinicians are susceptible to the all common human information processing errors^[17-19]. One of the most notable information processing errors in assessment

is stereotyping^[18]. Clinicians often make decisions of diagnosis based upon how much a client resembles their own personal prototype, a mental conception for the most typical client with that diagnosis^[19]. As such, clinicians' diagnoses can be influenced by client characteristics that are not related to diagnostic criteria, such as race, sex, and occupation^[20-22]. The inflexibility of this prototypical stereotype bias can quite often lead to misdiagnosing clients^[19]. Unfortunately, the issue of practitioner information processing errors is not easily remedied; clinical judgment improves only slightly with education, training, and/or experience^[23,24]. This may partially be since it is rare for clinicians to receive timely and effective feedback about their decisions^[17]. Clinicians may engage in faulty strategies when hypothesis testing^[24], often falling prey to confirmation bias by unwittingly seeking information that confirms the accuracy of their judgment as opposed to seeking out information that would refute it^[25]. Accurate feedback may be essential to the process of learning from experience^[26], though the literature is still unclear as to whether this is true specifically for clinical judgment^[23].

The concerns of client self-report and clinician judgment extend beyond just the initial diagnosis. Disagreement between client self-report and clinical judgment occurs before treatment and at the end of treatment^[14], impacting treatment efficacy assessment. This is true for both clinical trials and individual case formulation, and can lead to erroneously continuing ineffective treatment, discontinuation of effective treatment, or prematurely terminating treatment with individuals who would benefit from further services. A more objective and change-sensitive method of assessment would provide the clinician with immediate feedback to reduce the prevalence of these treatment plan errors.

In summation, the DSM-5 used a categorical system for diagnoses whose severity and type appear to be better represented on a dimensional scale^[27,28] and the standard practice of assessment uses a variety of kinds of client self-report and clinical judgment measures, which are both highly subjective. In addition to these general issues, the problems with the current diagnostic and assessment system for anxiety disorders specifically are many and varied. This has led in part to the anxiety disorders being among the most misdiagnosed^[29]. Because of the flaws in the current system, we suggest that the development, integration, and adoption of a more objective and change-sensitive measure of diagnostic status is imperative. We propose that one or more standardized biobehavioral methods of assessment may be the solution.

Why do we use the term biobehavioral? Years of medical and psychological research have demonstrated that psychological conditions have significant physiological impacts, and vice versa^[30]. For example, many people suffering from clinical depression show cellular alterations that result in lower levels of immunity than healthy populations^[31]. Many diseases progress more

rapidly when accompanied by poor mental health^[32]. Inversely, physical conditions such as chronic pain can have deleterious effects on mental health^[33]. Integrating psychological, behavioral, and biological factors when studying or improving mental health is referred to as the biobehavioral approach^[30]. This approach affords clinicians and researchers quantitative information about an individual, and increases the resources available for treating mental health conditions.

Vast advances in a variety of biobehavioral measurement tools have been developed and refined across the last 30 years. Biobehavioral devices provide unbiased reports of physical behavior and biological processes. Electrocardiogram (ECG) and eye tracking devices are powerful and sensitive tools of biobehavioral assessment that were traditionally limited to only top of the line medical and research facilities due to their once exorbitant cost. Recently, more cost effective versions of these devices have been developed which greatly increases the accessibility and utility of such tools for clinical settings. Despite their greatly decreased cost, the sensitivity of these tools are very promising for identifying unique symptoms of anxiety disorders salient to accurate differential diagnoses^[34]. Incorporating a biobehavioral, dimensional component to the DSM's categorical system of diagnosis would make psychiatric classification more in line with other medical classification systems^[13]. For instance, hypertension is diagnosed partially based upon a doctor's clinical judgment, but is accompanied by physiological, dimensional measures, namely systolic and diastolic blood pressure reading^[13].

The purpose of this paper is to discuss the current research status of two of the most well-researched and easily accessible biobehavioral tools and suggest future research directions to be taken to validate and incorporate their use in both diagnostic assessment and treatment outcome evaluations. First, the basic characteristics of several anxiety-related disorders and commonly co-occurring disorders will be reviewed. Second, a summary of the data captured by eye-tracking technology and a description of several affordable tools that are currently available is provided, followed by a review of the available literature on the discriminative ability of eye-tracking research. Third, descriptions of the most relevant information captured through ECG devices and affordable devices available are presented, along with how this data can assist in monitoring real-time change in symptomology.

ANXIETY AND RELATED DISORDERS

The DSM-5 taxonomy is loosely based on clustering disorders by similar symptomatologic features, but not necessarily by similarities in clinical presentation such as age of onset^[13,35]. The specified DSM-5 disorders placed in the category for anxiety disorders are separation anxiety disorder, selective mutism, specific phobia, social anxiety disorder (SAD), panic disorder (PD), agoraphobia, and generalized anxiety disorder (GAD).

A more accurate term for this group may be fear and anxiety disorders, because while these constructs are interrelated, they are different, and some of these disorders have a much more prominent fear component while others are more anxiety-based^[2,35]. Fear is an emotional, cognitive, and physiological response to and directed at a present threat^[36]. Anxiety is also a distressing emotion, but it is typically characterized by future-oriented, threat-focused cognitions and a perceived state of ambiguity or uncertainty^[36]. Both anxiety and fear states are characterized by heightened autonomic arousal which is demonstrated through multiple physiological reactions.

There is little to no research on the biobehavioral reactions of individuals with separation anxiety disorder, selective mutism, PD, and agoraphobia. For this reason, this paper focuses on GAD, specific phobia, and SAD. GAD is characterized by excessive and uncontrollable worry. The symptoms are the result of the interaction between cognitive and physiological responses to imagined or perceived threats^[37]. Individuals with GAD are consumed by monitoring and avoiding potential sources of threat and danger. Specific phobias are characterized by an immediate, extreme, and persistent fear toward an object or situation, and thus are more fear-based than anxiety-based^[1]. SAD is characterized by persistent fears of social interactions or situations in which criticism and rejection by others is possible^[1]. Individuals with SAD are extremely critical of their social performance and are anxious about whether they will be able to make positive impressions or live up to social expectations^[38].

The anxiety disorder cluster is, by no means, a comprehensive grouping of all disorders with a significant anxiety component. Several other disorders are also defined in part by extremely high levels of anxiety. Most notably, posttraumatic stress disorder (PTSD) and obsessive compulsive disorder (OCD) are comprised of symptoms that clearly denote high levels of anxiety. To qualify for a post-traumatic stress disorder diagnosis a person must experience a traumatic event and then experience intrusive dreams, memories, dissociative, distressing, and/or physiological reactions and hyperarousal that lasts for at least one month in duration after experiencing the traumatic event^[1]. Obsessive compulsive disorder is characterized by obsessions and/or compulsions. Obsessions are unwanted and intrusive images, impulses, thoughts, or ideas that are threatening, nonsensical, disgusting, or obscene^[39]. These obsessions are categorized into six categories: Contamination, violence, sex, religion, the need for exactness, or responsibility for harm^[40,41]. Each type of obsession causes distress and functional impairment. Most people with OCD also experience compulsions, the strong urge to engage in an action, whether mental or physical, to reduce the anxiety caused by the obsession^[39]. The overlap in diagnostic criteria for PD, agoraphobia, social phobia, specific phobia, GAD, OCD, and PTSD can make diagnosis

based on self-report and clinical judgment difficult. For example, a fear of dirt can either be part of a specific phobia or a component of OCD for an individual with a contamination obsession. Fear of a location could be associated with a specific phobia, be related to a fear of being unable to escape (as in Agoraphobia), tied to a traumatic event, or be due to fear of being judged by the people in that location (as in SAD). Under the current diagnostic system, accurate and thorough client self-report is imperative to correctly categorizing these symptoms into the appropriate diagnostic box, which as previously discussed, is unlikely to consistently occur.

In addition to the issue of co-occurrence and misdiagnosis within the fear and anxiety related disorders, the disorders also frequently co-occur with and are misdiagnosed for disorders from other categories. There are relatively high rates of co-occurrence between major depressive disorder (MDD) and each of the disorders mentioned above, particularly with GAD^[42]. Major depressive disorder has so much in common with GAD and PTSD, that an alternate empirically-based structure was proposed for the DSM-5 with MDD, GAD, and PTSD in a category together called "Distress Disorders", while the other disorders listed above were placed in a separate "Fear Disorders" category^[13,35]. There is also significant overlap between the anxiety disorders and attention-deficit/hyperactivity disorder (ADHD), with nearly half of the individuals with an ADHD diagnosis having a comorbid anxiety disorder^[43]. However, this is, likely, partially due to misdiagnosis^[44]. ADHD is characterized primarily by impulsivity and inattention^[1]. People with high levels of anxiety often have difficulty concentrating and maintaining attention^[45]. They may also act abruptly in ways that appear highly impulsive, due to their desire to avoid fear-inducing stimuli or, in the case of OCD, due to a compulsion to complete certain behaviors. Understanding a client's internal processes related to these behavioral symptoms is imperative to accurate differential diagnosis between these disorders. Self-report can be a helpful tool to this end, but biobehavioral measures of physiological markers through eye-tracking can provide insight into internal processes which may assist in differentially diagnosing ADHD and MDD from disorders like OCD, PTSD, GAD, SAD, and specific phobia, especially in cases where a client has a lack of insight or where there are barriers to accurate verbal communication. Eye-tracking and ECG devices can also provide clinicians with detailed and change-sensitive measures of symptomatology which can assist in evaluating the course of a disorder and efficacy of treatment.

EYE TRACKING AND ANXIETY

Eye-tracking technology has made it possible to measure certain physiological markers, that contain covert information about individuals, such as pupil dilation, eye-movements, and fixations^[46]. For example, due to the established relationship between dopamine

and blinking, blink rate has been frequently used as a marker for dopamine^[47]. Additionally, changes in pupil size when viewing sad stimuli has served as a predictor for depression^[48]. The eye has many behaviors, each one indicative of other things happening within the individual. For our purposes, there are three important behaviors of the eye that eye-trackers are successful in accurately measuring. First are saccades, those rapid eye-movements that occur consciously and unconsciously when changing fixation points^[45]. These are one of the most common types of eye-movements and the ones typically measured when using eye-tracking technology^[49].

Second are fixations, purposeful stops of the eye on a specific part of the visual environment and represent where visual attention is being allocated^[45]. A fixation occurs between saccades when the eye is stationary, and are valuable for several reasons. First, they show the type of stimuli on which a person is focused (e.g., sad faces). Second, the frequency and duration of fixations can yield information about an individual's condition (e.g., fixation duration can be indicative of current mood)^[50]. Lastly, different stimuli can change an individual's fixation patterns, which can in turn influence how the stimuli are perceived by the viewer^[51,52].

The third behavior is pupillary size, which has served as an indirect measure of neurological functioning for many years in the medical field^[53]. Pupillometry, the method of recording pupil diameter, has made its way into other fields and is now commonly used as an indirect measure of cognitive load, attention, and emotional arousal in psychology^[34,54]. As previously discussed, clients are not always honest, and many times, they are unaware of certain relevant information about themselves. The pupil is a gateway to certain aspects of the brain and can make this hidden information accessible. For example, pupil diameter increases when a person is looking at emotionally arousing stimuli as opposed to neutral stimuli^[34]. This can expose how certain things may influence more emotional arousal than others, even if the client has no desire or ability to communicate these differences. Incorporating measures of pupil diameter into a treatment plan would also be beneficial in instances where a client is experiencing anxiety, but is unable to pinpoint the major sources responsible for his anxiety. Tracking his pupil dilation while looking at stressful stimuli could reveal the primary areas of struggle.

The evolution of eye-trackers has paralleled that of computers. They have transformed from machines of massive proportions and immense costs to easily portable and affordable devices. Eye-trackers today come in a wide variety of sizes, prices, and capabilities. Eye-trackers recording at the minimum of 60-Hz have been validated as capable of accurately measuring pupil dilation^[55]. Most affordable eye-trackers on the market are capable of measuring at 60-Hz and above. One of the leading companies manufacturing portable eye trackers is Tobii. This Stockholm-based company sells

small, easy to set up, portable eye trackers for as low as € 159.00. The company Smooth Eye offers an eye tracker that samples at 1000 Hz, and they can design a customized eye-tracker to meet the client's needs. Pricing varies depending on the features wanted by the client. The Pupil Headset by Pupil Labs (€ 1640) is a complete headset that the client can wear for hours at a time without worrying about wires or remaining in the same spot. It is also possible to simply make an eye tracker; many websites offer step-by-step guides to building affordable eye-trackers. These are only a sample of the companies offering affordable eye-tracking devices. There are many more and each one offers different services and software. The affordability and portability of current eye-trackers make it possible for eye-tracking to become a standard tool used in psychology, and it may almost be time to move them from the research laboratory to the clinician's office. There is a great deal of promising research wherein eye trackers demonstrate their ability to assess types of anxiety (Table 1), but a consistent method of doing so has yet to be developed.

Using eye tracking to assess type of anxiety

One of the most common and useful behaviors that eye tracking technology captures is attentional bias. Attentional bias is the tendency to attend to certain stimuli at the expense of others, and is one of the most commonly measured behaviors in mental health-related eye-tracking studies^[56]. This bias is shaped by an individual's experiences and mental states. For example, people struggling with depression tend to focus on negative stimuli, while people with PTSD tend to focus on threatening stimuli^[57,58]. Negative attentional biases often turn into a malfunctioning cycle because the mental state that developed these negative attentional biases is only receiving reinforcing feedback, thus maintaining the condition^[59]. Fortunately, maladaptive attentional biases can change through treatment, and the progress of this change can be tracked through eye movements^[60].

In addition to providing insight into cognitive aspects, eye-tracking methods can also yield useful data that can help distinguish between commonly confused conditions^[61]. As previously mentioned, there is significant overlap between certain anxiety disorders and depression. People with anxiety display an orienting bias making them faster at detecting threatening stimuli^[62]. Additionally, people with anxiety make more frequent eye movements^[62]. Neither of these features are present in depressed or healthy populations^[50]. People with GAD selectively attend to different stimuli than people with depressive disorder and nonclinical populations. Interestingly, individuals with GAD who are not depressed orient to threatening faces before neutral faces^[63-65].

Eye-tracking studies on depression have found that depressed clients with no anxiety do not display hypervigilant eye-movements, but instead have longer

Table 1 Eye-tracking differences across DSM diagnoses

Eye tracker information pertinent to differential diagnosis	Anxiety	Generalized anxiety disorder	Depression	Phobia	SAD	Post-traumatic stress disorder	Obsessive compulsive disorder	Attention-deficit hyperactivity disorder
Attentional Bias (the tendency to attend to certain stimuli at the expense of others)		Tend to focus on threatening stimuli. Selectively attend to more threatening stimuli	Tend to focus on mood-congruent stimuli (<i>e.g.</i> , SAD, negative)	Tend to avoid feared stimuli	More sensitive to faces showing emotion over neutral faces	Tend to focus on threatening stimuli	Tend to focus on aversive stimuli	
Orienting Bias (faster detection of certain stimuli)	Faster detection of threatening stimuli	Faster detection of threatening stimuli. Orientation to threatening faces before neutral faces	Slower to detect threatening stimuli (compared to anxiety or generalized anxiety disorder)	Faster orientation to feared stimulus		Faster detection of threatening stimuli		
Frequency of eye movements	Higher frequency of eye-movements	Higher frequency of eye-movements	Slower frequency of eye movements than in anxiety or generalized anxiety disorder				More fixations during a visual search task than anxiety and nonclinical populations	Higher frequency of eye movements
Engagement/disengagement of stimuli				After detecting feared stimulus, quick with the stimulus	Takes longer to disengage from a threatening facial expression than other expressions	Do not show the same type of disengagement as people with a phobias		
Stimulus avoidance			Lack of interest in positive stimuli - focus instead on mood-congruent stimuli	After detecting feared stimulus - quick disengagement and avoidance of feared stimulus	Avoidance of eye-contact and faces in general, even if faces are pleasant. Correlation between severity of SAD and the amount of gaze avoidance			
Fixations, saccades, and pupil dilation	Make less fixations (closer to nonclinical populations) than people with obsessive compulsive disorder during a visual search task		Longer fixations on mood-congruent stimuli than those who have anxiety			Greater pupil dilation in general than nonclinical populations	Longer and more frequent fixations towards aversive stimuli. Deficits in goal-oriented visual tasks (higher error rates, inaccurate eye movements for the specific task)	Premature saccades occur more frequently than in nonclinical populations. Higher error rates on anti-saccades tasks than non-clinical populations

SAD: Social anxiety disorder.

fixations on mood-congruent stimuli (*e.g.*, sad faces), and show a lack of interest in positive stimuli^[50,66,67].

Some researchers refer to these tendencies as the double attentional bias, increased attention to sad faces along with decreased attention to happy faces^[68]. Clients with comorbid anxiety and depression pay attention to both types of stimuli^[66,67].

Phobics show specific orienting biases as well. People with phobias are faster at detecting their feared stimulus than normal populations^[69]. Unlike in people with PTSD, people with phobias tend to disengage with the threatening stimulus and avoid looking at it. While this behavior can occur in people with other types of anxieties, it is most pronounced when an individual with a phobia is presented with the feared stimulus^[50].

Gaze avoidance, or not looking at a stimulus, is easily measured with an eye-tracker, and is a physiological response that can consistently discriminate SAD from other disorders. Socially anxious individuals avoid making eye contact and looking at faces, whether a face is happy, negative (e.g., angry or sad), or neutral^[70]. Despite this consistent avoidance, these individuals rate these smiling faces as pleasant. This discrepancy between self-reported information and biobehavioral observable reaction exemplifies the unfortunate difficulty experienced by clinicians relying on self-report.

People with SAD avoid eye contact when receiving feedback whether it is positive or negative, a behavior not seen in people with GAD, depression, or PD^[71]. Although people with SAD avoid eye contact, they are more sensitive to faces showing emotion than neutral faces, and take longer to disengage attention from threatening facial expressions, such as faces expressing disgust^[72] and anger^[73]. Additionally, there is a correlation between the severity of SAD and the amount of gaze avoidance, making it possible to determine a client's level of social anxiety through eye-tracking tests^[63].

Eye-tracking studies show that people suffering from PTSD orient faster to threatening stimuli and show greater pupil dilation than nonclinical populations^[74]. People with PTSD show an attention bias towards trauma-related stimuli over general threatening stimuli, a bias not seen in healthy populations^[74]. For example, one study showed that people with a PTSD diagnosis made more initial fixations to threatening words than people who had experienced a trauma but did not qualify for a PTSD diagnosis^[51]. Pupil dilation differences in PTSD populations have also been reported, but more research is necessary for consistency. One study reported that people with severe symptoms of PTSD showed greater change in pupil dilation when viewing negative versus neutral images, followed by people with mild symptoms of PTSD, with nonclinical populations showing the least amount of change in pupil dilation^[75]. Another study failed to replicate this result, and found that people with a clinical diagnosis of PTSD had greater pupil dilation when viewing both neutral and threatening images than people who had experienced trauma but did not have enough symptoms for a PTSD diagnosis. There were no differences in baseline pupil dilation

between groups, indicating higher levels of autonomic arousal in the PTSD group^[51], which can be measured using pupil dilation as a marker.

There are inconsistencies in the research on the type of attentional biases displayed by populations with PTSD. Three different types have been reported: Facilitated attention (attending to threatening stimulus first), delayed disengagement (difficulty disengaging from threatening stimulus), and/or attentional avoidance (avoiding the threatening stimulus after it has been detected)^[76]. While some have found evidence for attentional avoidance, most studies have seen facilitated attention and delayed disengagement^[75]. A likely reason for this divide is the different experimental methods used in the studies. The inconsistencies in the methodology, type of stimuli, and type of task performed by participants are a likely reason for this disparity. Eye-tracking studies using similar methodologies have seen more consistent results^[74].

People with OCD have shown deficits in performance on goal-oriented visual tasks in eye-tracking studies, particularly higher error rates and inaccurate eye movements^[77]. Populations with OCD also tend to make longer and more frequent fixations towards aversive stimuli, a finding that could help identify obsession-type for clients^[78]. Another eye-tracking study by Toffolo *et al.*^[79] found that participants with OCD searched for longer and made more fixations during a visual search task than either participants with anxiety or a control group, a finding that helps differentiate the diagnosis of OCD and other anxiety disorders with biobehavioral data.

ADHD and anxiety disorders can often look similar at first glance. This can lead to mistakes in diagnoses and inefficient treatment plans for clients. Some of the deficits experienced by ADHD sufferers can be seen using eye-tracking methods. Eye-tracking studies have consistently found that people with ADHD make premature saccades more frequently and have higher errors on anti-saccades tasks than normal populations^[80,81]. These patterns reflect difficulties with inhibition, which is reciprocally related to impulsivity, and could be used to help avoid misdiagnosis.

Eye-tracking data have also demonstrated an impressive predictive ability. Several studies have found that difficulties disengaging visual attention predicts negative affect^[82,83]. Difficulty disengaging visual attention, especially from negative stimuli, is characteristic of people suffering from depression or dysphoria^[84-86]. Another study found that the eye-movements of anxious teenagers were more successful in predicting depression two years later than their own self-reported symptoms^[82]. While additional research is needed, these promising findings on predictability show yet another potential component of eye-tracking methodology.

Eye-tracking research is beginning to shed light on new ways to differentiate diagnoses. However, there are contradictions in the literature that merit focused

attention and more research. For example, some studies have found that people with anxiety were slower in naming words related to their anxieties when compared to words that had nothing to do with their anxieties^[59,87]. This contradicts the more common notion that people are faster at detecting stimuli related to their anxiety. Although these findings are contradicting, they still show that differences exist between participants with anxiety and healthy controls. It is necessary to conduct more research so that consistent findings can allow for the implementation of eye-tracking techniques in clinical settings.

HEART RATE VARIABILITY RESEARCH

The autonomic nervous system (ANS) regulates adaptive behavioral and physiological responses to environmental stress. Individuals with mood and anxiety disorders exhibit dysfunctional ANS regulation. The heart is an ideal and widely measured organ for assessing the influence of the ANS^[88], with heart rate variability (HRV) having been studied extensively. HRV is the variation of heart period over time, measured by ECG, and is a physiological indicator of cardiovascular health, predictor of mortality, and an important biomarker of psychological well-being^[89]. There are several heart rate frequencies and each of them are influenced by different factors^[90]. High-frequency HRV (HF-HRV) is associated with respiratory rhythm and it is regulated by parasympathetic neuroanatomical structures^[91]. HF-HRV is reduced in participants with anxiety disorders compared to healthy controls^[92].

Higher resting HF-HRV is associated with greater ability to regulate stress, attention, and emotional arousal^[93,94]. Low levels of HF-HRV regulation indicate poor social and emotional regulation, and in some cases have been associated with psychiatric disorders^[95]. For example, children with behavioral problems have lower HF-HRV, while children with reliable and stable HF-HRV display fewer behavioral problems, decreased negative affectivity, and better social skills^[96]. Higher HF-HRV has also been correlated with greater affect expressivity^[97]. Outside of mental health, physical factors including cardiovascular risk^[98], diabetes, and obesity are related to low HF-HRV^[99].

The 12-lead electrocardiogram has been used for diagnosis of heart disease and cardiac screening measure for over 100 years^[100]. However, a smaller number of ECG leads are sufficient to gather the required information to guide clinical practice and decisions. Advances in wireless technology and mobile communications enables real-time ECG recording directly from smartphones and tablets without the need for ECG machines, cumbersome leads, or trained professionals. Currently, there are several small cost-friendly devices that can record, monitor, and transmit ECG signals. These devices allow the possibility to record ECGs outside the laboratory in cost-efficient and timely manner. These mobile ECG work without

electrodes attached to the skin and burdensome experimental demands on the participant.

The AliveCor (\$99) device consists of a bipolar electrode case that fits on a smartphone to record cardiac electrical activity and software to process the information from the single lead ECG. The QardioCore (\$449) is a wearable ECG strap that is worn below the chest. The QardioCore records ECG measurements and sends them directly to a user-friendly application for mobile devices. The Cronovo (\$150) is a smartwatch with the capability of recording ECG and translates the data in real time for the consumer. The Lief Smart Patch (\$229) is a device that is worn directly on the skin that is capable of continuously recording HRV and providing direct biofeedback relaxation exercises.

The AliveCor can record accurate baseline measurements and detect cardiac abnormalities^[100]. Furthermore, participants preferred the mobile ECG devices to conventional 12 lead ECG because it less burdensome and allows data to be shared directly with their healthcare providers. Mobile ECG acquisition is more cost-friendly, faster, less burdensome, and allows clinicians to review data remotely. The mobile technologies make it easier to record ECG at any time and allows for clinical studies to be conducted on a new scale. It is now possible to collect ECG data from individuals from several different countries and populations quickly and cheaply. However, some of the devices are unable to continuously record ECG data, but those devices would dovetail nicely with ecological momentary assessment studies and provide an objective measurement along with self-report. Several of these devices have not been fully vetted by empirical studies. Therefore, future research is necessary to support the usage of these devices for diagnostic assessment and treatment outcome.

The wearable health and fitness device market is growing; it is estimated that 19 million people will be wearing this technology in the next 5 years^[101]. In October 2014, the FDA approved the use of smartphone ECG, before devices were restricted to heart rate and activity monitoring. Future technological advancements in wearable health monitoring will more than likely include continuous ECG recording.

Clinical applications of measuring HRV

Coupling mobile HRV with biofeedback is an effective treatment for anxiety disorders^[102,103]. HRV biofeedback reduces autonomic hyperactivity and helps the individual learn how to regulate homeostatic mechanisms. HRV biofeedback promotes relaxation and increases vagal activity^[104]. Mobile biofeedback devices are beneficial because they provide patients with an objective measure of their physiology, rather than only relying on subjective self-report.

In the anxiety related disorders there are symptoms that denote the involvement of the ANS^[105]. These include rapid breathing, suppressed digestive processing, pupil dilation, endorphin release, heart palpitations, and reflex acceleration^[104,106]. These

physiological responses prepare the body for action and are adaptive responses when real danger is present, but this response system is maladaptive when no actual danger is present, as often occurs in the anxiety disorders^[106]. Individuals with clinical levels of anxiety exhibit less suppression of HF-HRV^[107]. Poor HF-HRV regulation in adults has also been associated with greater social anxiety^[108]. The close link between HF-HRV and anxiety disorders has been examined in PD^[109,110], in GAD^[111,112], SAD^[110], and PTSD^[113].

The subjective experience of SAD is extremely distressing, as are the physiological sensations associated with the disorder (e.g., palpitations, sweating, tremors, muscle tension, blushing, diarrhea, gastrointestinal discomfort). SAD is characterized by social avoidance and disengagement, which are associated with dysfunctional autonomic processes. These dysfunctional autonomic processes are exhibited through social inhibition, emotional dysregulation, and fear. Individuals with SAD exhibit diminished HRV during baseline measures compared to healthy controls^[114].

GAD is associated with physical symptoms of restlessness, fatigue, difficulty concentrating, irritability, muscle tension, and sleep disturbance^[11]. Individuals with anxiety disorders such as GAD, do not show typical cardiac vagal activity in response to threat. Individuals with GAD display a reduction in HRV through a lack of autonomic reactivity^[115]. Individuals with GAD have high stable heart rate and low HRV^[88]. Empirical studies find that worry suppresses HF-HRV in non-anxious controls^[116]. Worrying thinking before exposure to imagery inhibits cardiovascular activity^[117]. Inducing worry suppresses HF-HRV in both non-anxious and anxious individuals^[118].

There is some variability among the anxiety disorders in physiological response. For PD there is some degree of fight-flight behavioral and physiological reaction. Individuals with PD exhibit reduced HRV^[119,120] and dysregulated respiratory system^[115-116], which suggests dysfunctional vagal activation and hyperactive sympathetic processes during challenging situations^[105]. Conversely, during non-challenging situations individuals with PD exhibit increased vagal withdrawal and hyperactive parasympathetic activation^[120]. Several studies have found conflicting results between individuals with PD and healthy controls on HRV^[105,121]. The incongruent findings may be due these studies having different methodological approaches and forms of analysis than other. Nonlinear dynamical theory may provide additional insight into the nonlinear relationship between heart rate variability and psychopathology^[121].

Specific phobias are characterized by increased heart rate and skin conductance when the individuals with the disorder are confronted with the fear object^[122]. Increased arousal is common among the specific phobias, while blood-injection-injury phobias have a unique physiological response that includes fainting. Individuals with dental phobia when exposed to phobia similar stimuli exhibit decreased HRV^[123].

Individuals with OCD are characterized by intrusive thoughts and irresistible urges to perform ritualized behavior. When individuals attempt to control these thoughts or behaviors, autonomic nervous system (ANS) activity increases. HRV has not been extensively studied in OCD and the few studies that have been performed have produced conflicting results. Some studies found increased levels of heart rate and skin conductance^[124], while other found no justifiable differences between controls^[125,126]. Using spectral analysis Slapp *et al.*^[105] found no differences between individuals with OCD and healthy controls on resting HRV. However, this study reported null findings on HRV between PD and healthy controls, which contradicts the established literature. Pittig *et al.*^[112] found that individuals with OCD exhibited diminished HRV during experimental tasks. These results need to be interpreted with caution because of a small sample size and the researchers did not account for the effects of medication. It is evident from the dearth of research on OCD and HRV that more work needs to be done to examine this relationship.

Physiological reactivity to reminders of a traumatic event is a characteristic feature of PTSD^[89]. PTSD populations have an average heart rate resting rate approximately five beats per minute faster than control groups^[127]. Higher resting heart rate and greater heart rate activity to trauma cues in individuals with PTSD have been explained as over activation of the ANS^[89,128]. The inability to regulate levels of arousal and distress is central to PTSD^[129]. The psychophysiological symptoms of PTSD include hyperarousal (e.g., excessive startle reflex, hypervigilance) and exaggerated reactions to trauma cues, which indicate a dysfunctional physiological stress system in individuals with PTSD^[130].

The role of cardiac activity in the ANS has been extensively studied in trauma research^[131,132]. Abnormalities in heart rate to trauma related a stimulus has been exhibited in a plethora of PTSD samples^[89,113,130]. Individuals with PTSD exhibit elevated tonic cardiovascular activity^[113,127] and excessive heart rate reactivity to trauma reminders^[113,128]. In contrast, some trauma-exposed individuals respond with a reduced basal HR (hypoarousal) or even dissociation when confronted with trauma cues^[133]. Individuals with PTSD compared to trauma-exposed individuals without PTSD exhibited amplified heart rate, attenuated respiration, and decreased HF-HRV^[134]. These differences are exaggerated when individuals are exposed to trauma-specific stimuli. Individuals with PTSD tend to remain physiologically aroused and fail to return to baseline levels^[113].

In summary, the majority of anxiety disorders exhibit significantly reduced HF-HRV than healthy controls during baseline measurement^[112]. Individuals with PD demonstrate the strongest differences between healthy controls on HRV^[109,112]. Individuals with GAD and SAD exhibit smaller effect sizes and exhibit less diminished HRV. Meta-analysis revealed significantly reduced HRV in individuals with PTSD, GAD, PD, SAD, and Specific Phobias compared to healthy controls^[91]. Therefore,

the anxiety related disorders exhibit unique biomarkers of psychopathology that are useful for diagnostic assessment, particularly differentiating from those without anxiety disorders. Additionally, HRV can be used effectively to objectively track treatment outcome for the anxiety-related disorders.

Heart rate variability has been extensively studied and validated as a biomarker of the anxiety related disorders^[135]. HF-HRV is a change-sensitive marker that parallels positive effects of treatment, with increases in HF-HRV following treatment for depression^[136]. Successful completion of cognitive behavioral therapy reduces psychophysiological activity in PTSD^[128,137], PD^[138,139], OCD^[140], GAD^[103], SAD^[141], and specific phobias^[142]. Therefore, HF-HRV is a potential biomarker of treatment efficacy for the anxiety related disorders^[135]. However, more research is needed to examine the efficacy of psychotherapy on HRV. Heart rate has been established as a biomarker of the efficacy of CBT on PTSD^[128,135,137]. Therefore, future research should examine the efficacy of CBT on the other anxiety disorders and if HRV can be considered a potential biomarker of treatment outcome.

DISCUSSION

Making accurate mental health diagnoses is not an easy task, especially when clinicians must rely primarily on client self-report, which can be inaccurate or misleading. Many disorders have similar symptomatology, and it can be difficult to untangle the many components to make an accurate diagnosis. Additionally, the DSM-5's categorical system can lead clinicians to make multiple diagnoses when there may be only one underlying condition responsible for the client's symptoms. While many clinicians have advocated for a dimensional model to solve these entanglements, the categorical model remains as the standard in the field. A promising solution to this quagmire would be to use biobehavioral assessments in clinical settings. The ample amount of research on heart rate variability and eye-tracking methodologies make it evident that these two measures are valuable for obtaining physiological data that is indicative of different aspects of mental health. These methods provide accurate and unbiased data (as opposed to self-report) that are useful in discriminating between disorders for diagnosis or evaluating treatment efficacy.

The multiple biomarkers that eye-trackers record provide abundant amounts of valuable data that can be used to differentially diagnose many anxiety-related disorders^[57,58,71]. ECG technology can provide clinicians with a clear visual of treatment efficacy for the anxiety related disorders^[135]. Integrating these biobehavioral devices into assessment will allow clinicians to make use of recent technological advancements in psychophysiology, years of research in biobehavioral markers, and assist clinicians in overcoming issues with self-report and human information processing errors. Using these methods could help psychological

assessment overcome the systemic flaws that have been endemic to psychological assessment and bring the system of psychological diagnosis out of the 20th century.

Imagine a common scenario, a mother brings her fidgety son, Jimmy, to her family doctor stating that he isn't doing well in school and seems distracted. She asks the physician for medication to help. Instead of the doctor asking a few hypothesis-congruent questions and prescribing ADHD medication, the physician instead asks Jimmy to put a watch on his wrist and look at a few pictures on the computer screen. A few minutes later, the doctor informs Jimmy's mom that it appears Jimmy has high levels of anxiety and is at-risk for future depression. The doctor subsequently refers Jimmy to a nearby mental health professional, who takes a closer look at the information and can see what types of attentional biases Jimmy exhibited during the assessment. Based upon this information, she can look more closely at the disorders Jimmy is most likely to have. The mental health practitioner also has information that can help her develop an accurate case formulation and determine which treatment is most likely to be effective. She also has established baseline anxiety levels that can be compared with later assessments to determine the efficacy of her treatment. This swift and objective assessment tool has the added benefit of fostering clear communication between medical professionals and mental health practitioners.

To make this vignette possible, several steps must be taken in this direction. While biobehavioral measures are becoming more prevalent, more research is needed to use these measures as resources for clinical settings. For instance, some of the research has yielded different results when analyzing the same constructs^[51,64,75,121]. One potential reason for some of the incongruent results on these studies is that each study utilized its own stimuli and methodological practices^[64]. To implement the use of these devices in a clinical setting, a standardized set of stimuli and methodology must be developed and validated. To do so, large scale studies with diverse populations comprised of clinical and healthy participants are needed. This requires funding and cooperative research relationships on a large scale. To this end, we exhort institutions to secure grants and other funding for this imperative research. Likewise, the United States Food and Drug Association (FDA) and European Medicines Agency (EMA) could encourage pharmaceutical and digital therapeutic companies to include biobehavioral measures as outcome measures when they file investigational new drug (IND) clinical plans. This could provide a more thorough picture of a treatment's efficacy and help standardize the use of biobehavioral measures in research and clinical practice.

Once a standardized set of stimuli and methodology are developed, new software would need to be developed to easily analyze the data for clinical use. It would be unrealistic to expect any general practitioner or master's level clinician considering a treatment path to painstakingly statistically analyze all the data involved

in these forms of assessment. A software program with the ability to print out easily discernible raw and standard scores would allow ECG and eye-tracker data to be interpreted in a similar manner to blood sugar readings or IQ test results.

There are several obstacles and opportunities for clinical psychology as a science and as a practice. Making these tools standard practice will be difficult, but it is possible and could resolve many of the issues currently plaguing clinical psychology. The fields of psychology and psychiatry can be serving people with anxiety disorders more efficiently and effectively, but a paradigm shift will need to occur. It would be best that as a discipline we can keep up with emerging technology instead of waiting for the current paradigm to be replaced by a better one^[143]. The process of implementing a difficult paradigm shift to incorporate the fruit of years of empirical research and technological advancement is well worth the discomfort of change and the inconvenience of validating and learning a new system of assessment.

In conclusion, many of the most troubling issues of the current system of mental health diagnosis and assessment would be greatly ameliorated by developing and utilizing a standard, objective, dimensional system through the use of eye trackers and electrocardiograms. Successfully changing the diagnostic system to include this new standard can be assisted by the concerted efforts of researchers, grant providers, government agencies, and clinicians. The benefits of including biobehavioral measures in mental health assessment far outweigh the effort it will take to make it a standard practice.

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Tattoos as a window to the psyche: How talking about skin art can inform psychiatric practice

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Abstract

Tattooing the skin as a means of personal expression is a ritualized practice that has been around for centuries across many different cultures. Accordingly, the symbolic meaning of tattoos has evolved over time and is highly individualized, from both the internal perspective of the wearer and the external perspective of an observer. Within modern Western societies through the 1970s, tattoos represented a cultural taboo, typically associated with those outside of the mainstream such as soldiers, incarcerated criminals, gang members, and others belonging to marginalized and counter-cultural groups. This paper aims to review the more recent epidemiology of tattoos in Western culture in order to establish that tattooing has become a mainstream phenomenon. We then review psychological and psychiatric aspects of tattoos, with a goal of revising outmoded stigmas about tattooing and helping clinicians working with tattooed patients to facilitate an exploration of the personal meaning of skin art and self-identity. We suggest that as a kind of augmentation of the physical exam, looking at and talking to patients about their tattoos can provide a valuable window into the psyche, informing clinical practice.

Key words: Tattoos; Military psychiatry; Deviance; Skin art; Psychopathology; Psychology

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Core tip: Although traditionally associated with deviance and psychopathology in modern Western culture, tattoos have evolved into a mainstream phenomenon, especially among younger adults. While there are myriad motivations for obtaining a tattoo, most individuals seek tattoos as a means of personal expression that provides a potential window into the psyche that can be used to facilitate psychiatric treatment. By reviewing the literature on psychological and psychiatric aspects of tattooing, we suggest that tattoos should be viewed not as signs of

pathology, but as opportunities to explore core aspects of self-identity that can be valuable in clinical work.

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CASE STUDY

Mr. A is a 31-year-old Caucasian United States Army veteran with post-traumatic stress disorder (PTSD) based on military combat experiences while deployed to Iraq and Afghanistan. He is a divorced father of two, currently in law school, with overall high functioning despite significant life challenges. A tumultuous childhood, including neglect and trauma at the hands of his mother and within the foster care system, led to several suicide attempts as a pre-teen and one psychiatric hospitalization where he was diagnosed with intermittent explosive disorder, bipolar disorder, and obsessive compulsive disorder. While medication titration was attempted during that hospitalization, he was never followed consistently by mental health as a child or adolescent, nor did he take psychiatric medication. Despite these developmental barriers, Mr. A was considered a gifted child with an intellectual capacity well beyond his years and background. At the age of 31, he presented for treatment of PTSD with bilateral full arm tattoos along with visible tattoos on his hands, knuckles, and the back of his neck. Later, he revealed that most of his body was covered with tattoos.

Discussions in psychotherapy revealed that he started getting tattooed at the age of 11, when his father forced him to learn how to fight, subjecting him to physical beatings in order to prepare him for the violent realities of his neighborhood. His first tattoos declared affiliation with his ethnic background, depicting themes of racial affiliation and violence that reflected long-time engagement with racially-based groups for the purpose of enhancing survival on the dangerous streets of his childhood home and within the juvenile corrections system. Other tattoos, including women in bondage, wizards, and skulls, were described as "filler", while others displaying religious symbols, weapons, references to Greek philosophy, and military themes seemed to be more personal. One tattoo referenced the names of fellow soldiers who were killed in action during the wars in Iraq and Afghanistan.

When asked about his motivation for joining the military he replied, "I needed to find a way to maintain masculinity without being a convict". Although he claimed to have thrived within military culture, he often clashed with superiors when he felt disrespected.

During deployments, he accumulated extensive combat experience where he expected to die. However, he ultimately completed his military service and after an initial period of instability that included intoxicated fighting and divorce, he obtained sobriety and decided to go to law school. At the time of enrolling in treatment, he was living with a long-time girlfriend while maintaining partial custody of two children from his previous marriage. As psychotherapy began, he demonstrated notable difficulty discussing his emotions and was resistant to the therapist's attempts to delve further into past and current relationships and his symptoms of PTSD.

REVIEW METHODOLOGY

An online search of PubMed and PsycInfo databases was performed using the search terms "tattoos", "tattooing", "tattoo", "skin art", "epidemiology", "stigma", "psychiatric disorders", "psychology", "perception", "self-perception", "removal", "depression", "anxiety", "self-harm", "deviance", "psychopathology", "prison", "military", and "veterans". Criteria for inclusion were original research involving human subjects, meta-analyses, reviews, published in the English language between January 1, 1990 and February 1, 2016 (with the exception of reference 7 which was included for historical purposes). The bibliographies of articles identified through electronic search were also reviewed for additional relevant publications including online resources such as the Harris Poll and military service regulations. Dissertations were excluded. Articles with a primary focus on dermatological/physical/physiological reactions to tattooing and tattoo removal or on diagnosis and treatment of the infectious sequelae of tattoos were excluded.

EPIDEMIOLOGY

Until recently, tattoos have represented a cultural taboo in modern Western societies, typically associated with those outside of the mainstream such as sailors, soldiers, incarcerated criminals, gang members, prostitutes, and others belonging to marginalized and counter-cultural groups^[1,2]. Over the past two decades however, epidemiologic studies have demonstrated that tattooing has become more of a mainstream phenomenon, with decreasing associations with stigma.

A survey of 500 population-representative United States respondents age 18-50 years old performed in 2004 revealed that 24% ($n = 120$) had tattoos with an additional 21% reporting that they had considered obtaining one^[3]. Overall, 65% of tattooed respondents reported obtaining their first tattoo by age 24, with women more likely than men to be > 30 years old when they obtained their first tattoo. Tattooed respondents mostly had their tattoos done within the United States (98%), usually in professional tattoo parlors (80%),

with tattoos obtained *via* homemade tattooing devices or sewing needles more likely to have been obtained at < 18 years of age. No tattooed respondents ever had a tattoo removed. Very few tattooed respondents reported being treated differently in work or social settings due to tattoos, suggesting that stigma surrounding tattoos has faded along with increasing popularity.

A more recent Harris poll of 2225 United States respondents performed in 2015 found that 29% of Americans had at least one tattoo, an increase from 14% in 2008 and 21% in 2012^[4]. Tattoos were slightly more common among United States women (31%) than men (27%). Younger respondents were more likely to have tattoos, with nearly half (47%) of those 18-35 years old reporting that they had a tattoo. Regret about having a tattoo was reported in 23% of respondents, an increase from 14%-17% in previous years. Based on limited sample sizes from these two surveys, it therefore appears that tattooing has become much more common in the United States, particularly among young adults where rates may approach 1 in 2.

Looking more globally at industrialized Western societies, Kluger published a review of epidemiologic studies performed in the United States, Canada, Australia, Europe, and South America, reporting that the prevalence of tattooing is around 10%-20%^[5]. Consistent with data from the United States, tattooing is more common among younger people globally, with the "tattooed generation" born in the 1970s and early 1980s. Being in a tattooed peer group or having a tattooed family member was linked to higher rates of possessing tattoos (75% and 29% respectively). Although tattoos have been traditionally more common among men, gender divides have lessened to the degree of extinction in recent decades in some countries, with tattooing now more common in women overall compared to men in the United States and more common among women 20-29 years old in Australia. However, women tend to have smaller and less visible tattoos overall and prevalence data might be skewed by the inclusion of cosmetic or "permanent make-up" tattoos.

In addition to general prevalence data, Kruger noted that tattoos remain common in groups most traditionally associated with tattooing^[5]. For example, the prevalence of tattoos among United States Navy personnel in World War II was 65%, while the modern prevalence of tattoos among those in the military is cited as ranging widely from 10%-44%. Differences in rates may reflect variations in sanctioning within separate settings, with peer group pressure playing a significant role. In Brazil for example, tattooing was not introduced until 1959 and the practice is illegal for minors in some states^[6]. A survey conducted among a sample of 18-year-old Brazilian military recruits ($n = 1968$) revealed that about 11% of recruits had tattoos, of which 66% had a single tattoo and 21% had two tattoos, with the remainder having > 2 tattoos^[6]. A large majority of tattooed recruits (80%) had obtained

their first tattoo before the age of 18.

Despite the illegality of getting tattooed in most prisons worldwide, tattooing remains a common practice among inmates, with prevalence rates ranging from 9%-70%, depending on location, and some 40% of all inmates obtaining a tattoo while incarcerated^[5]. Tattoos in the incarcerated population serve to align the wearer with a specific group, as a remembrance, as a sign of strength or aggressiveness, or to simply help to pass the time. Due to the makeshift nature of prison tattooing, inmates are at high risk for obtaining blood borne illnesses such as hepatitis C and human immunodeficiency virus (HIV).

WHAT DO TATTOOS TELL US ABOUT THEIR WEARERS?

Evolutionary and historical perspectives

Tattooing has been a human practice for more than 5000 years, leading Carmen *et al.*^[2] to examine tattoos through an evolutionary lens. They hypothesized that, regardless of the proximal motivations for getting a tattoo (*e.g.*, commemorating an event or relationship, designating group affiliation, or serving as a marker of individuality), the ultimate evolutionary purpose is by definition rooted in sexual selection. The authors offered two hypotheses to explain how tattooing might have been favored in evolution that they call the "human canvas" and the "upping the ante" theories. The former postulates that tattooing is an expression of human culture based in "symbolic thought", with the artistic canvas as a means to illustrate one's personal story and to document history, moving from cave walls to the skin over time. The "upping the ante" theory suggests that tattoos evolved as a fitness indicator, enhancing one's appearance in the context of intersexual competition, similar to a peacock's tail. In tracing the evolution of tattooing across history starting from its ritualistic tribal origins, the authors note that the modern rise in the popularity of tattoos within Western culture emerged from individual niches such as military culture during World Wars I and II, the subsequent countercultural movements of the 1960s and 1970s, and the current cultural mainstream as a status quo. Over time, social stigmas have lessened and technical innovations have reduced the infectious risk of tattooing, such that it has become a less "costly" and therefore more common fitness indicator.

Psychoanalytic perspectives

Like Carmen *et al.*^[2], Grumet^[7] tracked the development of tattoos throughout history, but did so through a lens of psychodynamic psychiatry as opposed to evolution. Although he acknowledged that tattoos could proclaim identity and group allegiance (as with military tattoos), he argued that "tattoo analysis" ought to be used as a kind of "dermal diagnosis", with tattoos almost uniformly serving as a sign of psychopathology. For example, he

suggested that tattoos are rooted in antisociality and exhibitionism and that “outcasts and outlaws” obtain tattoos in order to bolster low self-esteem. He concluded that tattoos should be viewed as “a psychic crutch aimed to repair a crippled self-image, inspire hope, keep noxious emotions at bay, and reduce the discrepancy between the individual and his aspirations”^[7].

In a more recent analytic summary of unconscious motivations for tattoos, Karacaoglan^[8] utilized a case series to illustrate that “the painful penetration of the skin in the process of tattooing... is a form of acting out” and that tattoos symbolize “an attempt to actively represent and recompense, as it were, an early deficiency” and a “dialectical record of the mother-father relationship”. Highlighting the masochistic nature of tattooing, the author interprets tattooing as an alternative form of expression that patients “resort” to when unable to verbalize “unendurable affect” through language. Like Grumet^[7], Karacaoglan^[8] ultimately concluded that tattooing is a “form of perversion”.

While we agree on the potential value “dermal diagnosis” in exploring unconscious motivations for obtaining tattoos, these uniformly pathologic interpretations now seem, in light of the ubiquity of tattoos in mainstream culture, like antiquated generalizations. While an individual’s tattoos could indeed be used to inform psychodynamic psychotherapy by tapping into personal self-representation through symbolism, their interpretation need not be restricted to the realm of psychopathology.

Motivations for tattooing

In keeping with the view that tattoos should not be solely regarded as reflections of psychopathology, Wohlrab *et al*^[1] reviewed studies exploring the myriad motivations for obtaining tattoos. The desire to create and maintain a distinct self-identity by controlling one’s appearance is cited as one of the most common reasons for tattooing. This motivation may be especially age-relevant and helps to explain the desire to obtain a tattoo during adolescence and young adulthood. In addition to the more identity-based, personal narrative, and group-oriented motivations for getting tattoos, some studies suggest that tattoos can also be viewed as a means to embellish the body as a fashion accessory or piece of art to wear on the body. Others have noted that tattooing can serve as a kind of badge that reflects pain tolerance and physical endurance, as a means of emphasizing sexuality, and as an affiliation with a religious or spiritual tradition, while tattoos are also sometimes obtained impulsively for no specific reason.

Based on a literature review, Dickson *et al*^[9] likewise enumerated a variety of motivations for getting tattoos, including body adornment and personal decoration, expressions of individualism and markers of identity, and overcoming difficult emotions as a means of affect management. Motivations for tattooing vary between genders, with women more likely to seek tattoos for

personal decoration and to feel more independent, and men more likely to use them as symbols of group identity. Contrary to traditional stereotypes, most adults with tattoos do not associate them with rebelliousness or cultural alienation, do not usually obtain them impulsively or while intoxicated, and do not regret getting them afterwards.

In order to test these generalizations, Dickson *et al*^[9] administered a survey about tattoos to 458 United States college students, including 43% with at least one tattoo. The survey results confirmed that most tattooed respondents had taken months to decide what tattoo to get, obtained the tattoo in a reputable tattoo parlor, spent a significant amount of money on it, and tended to have been ≥ 18 years old at the time of their first tattoo. Respondents tended to view their tattoos as a means of self-distinction, rating them as having significant personal meaning as opposed to symbols of rebelliousness. While respondents reported very high levels of satisfaction with their first tattoo, those with multiple tattoos (60% of the tattooed sample) tended to rate their second or third tattoos, typically obtained a few years after their first, as favorites. This suggests that the process of obtaining multiple tattoos reflects a self-concept that continually evolves with time. For the majority of survey respondents who didn’t have tattoos, reasons cited to forgo tattooing included not liking tattoos, concerns about permanency, anticipated disapproval from family, fear of pain, and not knowing what kind of tattoo to get.

Psychopathology and personality traits in tattooed individuals

Although several studies have indicated a greater prevalence of tattoos among psychiatric samples compared to the general population, the data to support this conclusion are largely drawn from older studies based on comparisons of cross-sectional measures of psychopathology among tattooed individuals in either non-psychiatric settings or psychiatric settings with inadequate controls between samples^[10]. For example, Birmingham *et al*^[11] reported an association between tattoos and a diagnosis of schizophrenia, but their study was based on a limited sample of male prisoners with visible tattoos. Two studies have reported an association between tattoos and a history of abuse, but both included individuals with body piercings^[12,13] and one was based on responses to a survey published in a German body modification magazine^[12]. Studies of such specialty populations may have limited generalizability due to other confounds that might better explain associations with psychopathology. Similarly, reported associations between tattoos and risk-taking behaviors such as drug use, early sexual activity, gang affiliation, and violent behavior have typically been drawn from small studies of adolescents, with methodological problems related to sample population and size, survey techniques, and the potential for type I error^[5,14]. Taken in aggregate,

now that tattooing has become more common and is well-represented amongst adults, any associations with psychopathology are much less clear.

Looking again at recent epidemiologic data from the United States cited above, Laumann *et al.*^[3] reported that compared to non-tattooed individuals, tattooed respondents were more likely to use recreational drugs, more likely to have spent ≥ 3 d in jail, and less likely to claim religious affiliation, even when controlling for age^[3]. The percentage of tattooed respondents was lower among those who had never consumed alcohol. Among current drinkers, those with tattoos drank significantly more alcohol, although only a small minority of those tattooed had ever obtained their tattoos while intoxicated. Beyond the United States however, Kluger^[5] noted that an association between tattoos and alcohol usage has not been detected in surveys from other countries and is therefore not well established. On the other hand, associations between tattoos and both cigarette smoking and recreational drug use (especially cannabis) may be more consistent.

A number of studies have used psychological rating scales to explore potential personality differences between tattooed and non-tattooed individuals, with mixed results^[15]. Swami *et al.*^[15] administered a battery of inventories measuring various personality traits to a sample of 540 subjects from the southern German-speaking region of central Europe and found that those with tattoos only scored higher on measures of extraversion, experience seeking, and need for uniqueness. Although effect sizes were small to moderate, these results highlight that, if personality differences do exist among those with tattoos compared to the general population, they may not necessarily be dysfunctional or pathological. This conclusion is in keeping with recent findings from the United States in which the Community Body Modification Checklist was given to 213 adult subjects with and without tattoos or non-ear body piercings^[16]. Defying hypothesized expectations, Giles-Gorniak *et al.*^[16] reported that the only significant difference in mental health history and behavioral choices between the two groups was that those with body modifications were more likely to engage in social and healthy behaviors. Likewise, an Australian study employed the Loyola Generativity Scale to assess "concern for and commitment to the next generation" among 710 adult women and found that those with and without tattoos had equivalent levels of psychosocial health according to this measure^[17].

In contrast to these studies involving adults across the lifespan, much of the work to date on personality differences between tattooed and non-tattooed individuals has been performed in samples of college students, with limited generalizability. In order to avoid the methodological limitations of earlier studies, Tate and Shelton measured personality traits with validated scales that assessed for the Big Five Factors of personality (neuroticism, extraversion, openness to experience, agreeableness, conscientiousness), the need

for uniqueness, and the desire to be perceived favorably by others^[14]. Tattooed participants, as compared to their non-tattooed counterparts, scored significantly lower on agreeableness and conscientiousness and higher on need for uniqueness. However, while these differences were statistically significant, effect sizes were small and personality scores found among tattooed individuals were, with a single exception among women, within published norms. The authors therefore concluded that "it is untenable to refer to tattoos, per se, as signs of social deviance or personality and character flaws"^[14].

Suicide, self-injury, and tattoos

Tattooing is an inherently painful ritual that is usually voluntary, with a history of other acts of self-injury and of suicidal ideation sometimes noted anecdotally by recipients. A survey of 432 German adults with tattoos or non-ear body piercings found that 27% of respondents had a history of self-cutting during childhood^[18]. Comparing those with and without a history of self-cutting, self-cutters had the same average number of tattoos, but significantly more piercings. Curiously, some respondents reported feeling "healed" and stopping self-injurious behavior following body modification, leading the authors to hypothesize that some use body modification as a "therapeutic substitute" for "autoaggressive acts"^[18]. However, the inclusion of those with body piercings and the lack of a control group without body modification limits the generalizability of this conclusion to those with tattoos.

A possible association between eating disorders, self-injury, and tattoos was explored in a study of 65 female patients referred to a specialized unit for the treatment of anorexia, bulimia, and binge eating disorder^[19]. In this sample, a history of self-injury was reported in 51% of patients, while 27% had at least one tattoo. Having a tattoo was significantly associated with a history of burning, supporting the authors' conclusion that body modification might represent a form of self-punishment among those with eating disorders. However, 27% of the sample had tattoos and/or piercings without a history of self-injury and this subgroup had more positive feelings towards their bodies, higher levels of self-esteem, and less impulsivity, depression, anxiety, and social dysfunction than those with a history of self-injury. Therefore, tattoos may sometimes represent positive modifications of body image as opposed to markers of self-injurious behavior.

An association between tattoos and suicide was suggested in a study of 134 completed suicides over a 3-year period in Mobile County, Alabama^[20]. In this sample, 21% had one or more tattoos at time of death, with 57% of "young, white suicide" completers having tattoos compared to only 29% for matched accidental deaths. Another study involving a larger series of 438 autopsies in Linn County, Iowa over a 15-year period included 32% subjects with tattoos^[21]. Having a tattoo was associated with a significantly younger age at death and greater risk of death by an unnatural manner

(e.g., gunshot wound or drug overdose), but not suicide. Taken together, these small, regional studies offer conflicting evidence for tattoos being associated with suicide. Both studies did speculate that tattoos might be a potential marker of risk-taking behaviors and substance use that could in turn be associated with early mortality, but larger, epidemiologic studies are needed to more clearly elucidate associations between tattoos, self-injury, and early death.

Self-perception in tattooed individuals

Given the intimate and relatively permanent nature of tattooing, a tattoo is expected to alter the new wearer's perception of their body and their identity. However, the effect of the tattoo could depend on motivations for tattooing and the type and meaning of the tattooed image. A 2015 Harris Poll found that although most respondents did not feel that tattoos made them feel more sexy, attractive, rebellious, or spiritual, having a tattoo also did not make them feel less intelligent, respected, employable, or healthy^[4]. However, a substantial minority did report that having a tattoo made them feel more sexy (33%), attractive (32%), and rebellious (27%). Tattoos therefore seem to have the ability to positively impact one's sense of self, with individual variation and many aspects of identity potentially affected.

In an attempt to examine effects of tattoos on self-perception, Swami conducted a prospective study of adults from London who were planning to get their first tattoo by recruiting them in a tattoo shop^[22]. Participants ($n = 82$) were assessed before and after getting their first tattoo and asked to rate or provide information about the following aspects of self-perception: Their own overall physical appearance, anxiety about 16 different body sites, measures related to a positive body image, self-attributed need for uniqueness, social physique anxiety, self-esteem, desire to stand out with appearance, reasons for obtaining the tattoo, schematic outlines of the front and back of their bodies to ascertain tattoo visibility and percentage of body covered by the new tattoo, satisfaction with the tattoo, and likelihood of obtaining future tattoos. Assessments were conducted immediately before and after obtaining the tattoo, and then again after 3 wk. Immediately after getting the tattoo, both men and women reported reduced anxiety and less dissatisfaction around their appearance, effects that were sustained at 3-wk follow up. On 3-wk follow up, both genders also reported an overall increase in self-esteem. This suggests that tattoos can mitigate negative attitudes a wearer might hold about one's appearance. However, while men demonstrated a sustained decrease in social physique anxiety after obtaining a tattoo, female participants had higher social physique anxiety after 3 wk. The reason for this gender difference is unclear, but may be related to more negative perceptions towards women with tattoos in society. Still, no differences were found

between participants with visible tattoos and those easy to conceal, such that "corporeal meaning" appeared to be a more important predictor of self-perception than appearance, or how others might view them.

While this survey reported individuals' experiences and self-perception immediately before and after being tattooed, it did not examine self-perception in a more longitudinal fashion. It therefore remains unclear whether tattoos truly fulfill one's need for self-expression or if this need remains unfulfilled over time for some, leading them to find other means, or more tattoos, to validate uniqueness. Collectively however these findings suggest that at least in the short-term, tattoos have the power to improve self-esteem and satisfaction, with their appearance providing fertile ground for exploration in the therapeutic setting.

Tattoo removal

The data presented thus far give lie to the ever-present stereotype of tattoos being obtained by intoxicated youth who regret the act the next day, with up to 83% of wearers satisfied with their tattoos^[23]. Still, that leaves an estimated 20% of wearers who are dissatisfied with their tattoos and 6% who eventually opt for removal *via* surgical excision, dermabrasion, cryosurgery, chemical peels, and laser ablation with scarring, hypopigmentation, and incomplete removal as potential risks.

Armstrong *et al.*^[23] surveyed a sample of 196 subjects who sought tattoo removal from 4 clinics across the United States and found that the average person waited 10 years to do so. Frequent reasons for removal included "just decided to remove it", "suffered embarrassment", "got tired of it", "just grew up", and the need to hide the tattoo due to workplace stigma. Issues surrounding stigma were especially prevalent among women (see below for additional discussion).

Tattoo removal may be on the decline as societal acceptance of tattoos increases, with a 23% reduction in tattoo removal procedures reported by The American Society for Aesthetic Plastic Surgery between 2012 and 2013^[24]. This decrease is in contrast to a 52% increase reported by the American Society of Dermatologic Surgery over the same time period. However, tattoo removal does not necessarily reflect an overall dissatisfaction with tattoos. In the study by Armstrong *et al.*^[23], a third of subjects seeking removal were interested in getting more tattoos in the future, suggesting that for some the desire of ablation is more about specific tattoos rather than tattoos in general.

TATTOOS IN SPECIFIC POPULATIONS

Adolescents and tattoos

It is important to distinguish between tattoos among adolescents and adults, since motivations for obtaining tattoos may be significantly different between the two groups. In addition, while tattoos have become a more mainstream phenomenon among adults, considerable

stigma remains with tattooing as an adolescent^[25]. Significant research has been devoted to the study of tattoos in adolescents, highlighting negative associations with risk-taking behaviors such as substance abuse, smoking, sexual activity, violent behavior, and problems in school^[5]. However, such associations in adolescents < 18 years old are confounded by the fact that it is illegal for a minor to obtain a tattoo in all 50 of the United States. This suggests that tattooing may indeed be a signal of risk among minors, but those risks should not necessarily be extended to those obtaining tattoos as adults^[25].

With these demographic differences in mind, a prospective, longitudinal study followed a national sample of 13101 United States 7th-12th graders over 12 to 18 mo, looking at predictors of getting a tattoo^[25]. In their sample, adolescents who reported lower levels of parental and/or school attachment, lower grade point averages, and lower religiosity levels were more likely to have tattoos on follow up approximately 1-2 years later. The study also found that adolescents who used alcohol or marijuana and engaged in violent behavior were more likely to be tattooed at follow up. A history of violent victimization was also a significant antecedent of getting a tattoo, suggesting that some adolescents obtain tattoos as a method of self-protection. The authors conceded that the number of adolescents surveyed who later acquired tattoos was small (only 3.6% of sample), precluding any analysis of interaction effects^[25]. In addition, they did not take tattoo size, type, or location into account, which is potentially salient since such specifics might reflect different motivations for getting a tattoo (e.g., tattoos signaling affiliation with "conventional institutions" such as a sports team or school likely have very different meanings compared to a gang tattoo on one's neck). This caveat highlights that specific features of tattoos may have different implications about an individual, such that asking wearers about their tattoos may be a valuable source of information in terms of risk assessment, diagnosis, and general understanding. Methodological limitations aside however, it does appear that tattoos in adolescents can be thought of as representing a potential signal of risk among American adolescents.

Tattoos in the military

In modern Western culture, tattoos have been associated with soldiers for nearly a century, dating back to World Wars I and II^[2]. This may have contributed to early associations with tattoos as symbols of machismo or with tattooed individuals being tougher or more dangerous. Among current soldiers, the motivations for getting tattoos and their meanings are varied and diverse, with some important potential distinctions from the general population.

Recent data indicate that about a third of United States soldiers enter the military with pre-existing tattoos^[26], potentially reflecting character traits such as

increased novelty seeking, extraversion, and a drive for self-individualization that might be associated with both getting a tattoo and joining the military. A survey of tattooed soldiers ($n = 122$) in the United States Armed Forces found a wide variety of tattoo types, including tattoos reflecting themes of self-identification (military branch or unit designations, patriotic images, ethnic/cultural/tribal symbols), martial themes (weapons, symbols of death), spirituality (religious symbols and quotations, angels, devils), and nature (animals, trees/flowers/plants, and moon/sun/planet/stars)^[26].

Gadd conducted a survey of 445 British soldiers who presented to a military-run health clinic in 1990 and found that almost half had tattoos^[27]. Peer influence, moreso from male than female friends, was frequently cited as a motivating factor (64%). Nearly a third of tattooed soldiers reported regret associated with their tattoo and considered its removal, with such sentiments significantly more likely among those ≥ 26 years old. These findings suggest that military personnel may face peer pressure to get tattoos that results in higher levels of regret than is reported in the general public. Regret among older soldiers might likewise reflect a change in identity with which the tattoo did not keep pace, or represent reminders of military experiences one might prefer to forget. Tattoos among military personnel and veterans seeking psychiatric treatment might therefore offer especially valuable avenues to gain access to self-identities transformed by war and personal loss.

The United States military has a long history of maintaining strict standards about personal appearance and grooming, with exacting guidelines governing proper attire and hair length. With the modern frequency of tattoos among potential recruits and the evolution of tattoos away from a sign of rebellion, the United States Armed Forces have recently revised their rules about tattoos, representing a shifting balance between codes of discipline or uniformity and evolving societal views about tattoos.

No branch of the United States Armed Forces allows tattoos that are sexist, racist, extremist, or derogatory in content. The United States Army recently provided general rules prohibiting tattoos on the neck, head, face, or wrists, but personnel are allowed to have tattoos everywhere else on their bodies, including the arms and legs, which were historically forbidden^[28]. Hand tattoos are only permitted in the form of one ring on each hand in order to allow for tattooed wedding rings. The United States Marine Corps is currently updating its rules, but Marines are still not allowed to have tattoos covering the whole arm ("sleeves")^[29]. The United States Navy's regulations specify that no tattoos are allowed on the face, neck, scalp, or head^[30]. Tattoos exposed by wearing a short sleeve navy uniform shirt may be no larger in size than the wearer's hand with fingers extended and joined with the thumb touching the base of the index finger. In contrast to the other branches of the United States Armed Forces, the United States Air Force has relatively

strict rules, prohibiting excessive tattoos (partially defined as any tattoo that exceeds ¼ of the exposed body part) from being exposed or visible while in uniform^[31].

Concerns about tattoos in the United States Armed Forces seem to reflect an emphasis on discipline, uniformity, and a respect for command that might be compromised by obvious external markings that set an individual apart. However, as tattoos have become increasingly common and more societally acceptable, the military has in turn become more tolerant, allowing that tattoos might provide an acceptable symbol not of defiance, but individuation and a potential source of group cohesion.

HOW DO OTHERS PERCEIVE THOSE WITH TATTOOS?

General perceptions

Despite the rapidly changing societal views of tattoos, explicit and implicit biases continue to affect how tattooed individuals are perceived. A 2015 Harris Poll revealed that the majority of respondents stated that there was no difference in perceptions of rebelliousness, sexiness, spirituality, respectability, intelligence, or health for people with or without tattoos^[4]. However, for the substantial minority of respondents who did perceive a difference, people with tattoos were rated as more rebellious, but less attractive, sexy, spiritual, respectable, intelligent, and healthy.

Tattoo perceptions appear to vary according to the profession of the wearer, with more discomfort associated with visible tattoos on presidential candidates, judges, primary school teachers, and doctors compared to athletes, information technology technicians, and chefs^[4]. Due to the persistent disapproval of visible tattoos in some professional settings, some individuals might forgo tattooing altogether or hide their tattoos at work in order to avoid stigma. In the reverse direction, a 1998 survey found that physicians and registered nurses demonstrated negative biases against those with tattoos^[32]. Although the survey did not measure providers' actual attitudes towards their patients, it is important to be aware of the potential for negative bias as a clinician working with individuals with tattoos.

In reviewing the literature on tattoo perception, Burgess and Clark^[33] have noted that most tattoo perception studies to date have failed take into account the type of tattoo a participant possessed. This is an important omission that has likely contributed to generalizations about tattoos that are misleading in current society, where tattoos of all sizes, locations, and thematic imagery can be found. Tattoos can range from those that are concealed or visible only in more casual or intimate settings to prominent markings on the face, neck, and extremities. Designs can range from "small, trendy, and fun"^[33] fashion accessories to more complex tattoos displaying more provocative or sexual themes covering large portions of the wearer's body. Intuitively,

such widely varying differences in tattoos are expected to be salient in terms of impacting the perceptions of others. Such perceptions would also be expected to vary based on the gender or age of a wearer.

In order to test such hypotheses, Burgess and Clark^[33] performed a study in which 300 British university students were shown images of hypothetical male and female job applicants with either "cute" tattoos, "tribal" tattoos, or no tattoos. No tattoos and cute tattoos were associated with applicants being rated as more friendly and therefore suitable for the job in comparison to those applicants with tribal tattoos, who were perceived as more aggressive and less well suited. Negative dispositional characteristics were attributed exclusively to tribal tattoo wearers, which in turn negatively affected their perceived job suitability. This perception was more strongly held in respondents without tattoos compared to those with tattoos, or those who had considered getting one. This study therefore confirms that the content of a tattoo affects how the wearer is perceived, while also highlighting that tattooed individuals are generally less likely to infer negative attributes about another tattooed person. Therefore, while certain types of tattoos continue to trigger inferences about aggression and deviance, such attitudes may be shifting as more of the populace becomes tattooed.

Gender specific perceptions

Despite the increasing acceptance of tattoos in modern Western culture, women with tattoos still tend to be more negatively perceived than tattooed men. A 2004 survey of Canadian undergraduates reported that both male and female respondents had negative attitudes towards descriptions of women with visible tattoos, and that tattoo size was a predictor of disapproval for respondents who did not have tattoos themselves^[34]. Swami *et al.*^[35] extended upon this research by using line drawings of women with tattoos that allowed manipulation of tattoo location and the number of tattoos to assess effects on an observer's ratings of attractiveness, sexual promiscuity, and alcohol consumption. Based on a study sample of 160 British undergraduates, 14% of whom had tattoos, depictions of women with tattoos were rated as significantly less attractive, more sexually promiscuous, and heavier drinkers compared to women without tattoos. The likelihood of these perceptions increased with the number of tattoos, with figures bearing 3 tattoos estimated to drink more than twice the amount of alcohol as those without any tattoos. While the study was limited by the artificiality of the line drawings and the lack of a male figure control, it appears that tattoos among female college undergraduates may signal an increased likelihood of drinking alcohol and sexual activity. Despite these associations, 73% of the sample indicated that they would consider getting a tattoo in the future, and 53% of the sample was female. These caveats might therefore reflect not only less stigmatizing views of tattoos, but

also of alcohol and sexual activity (e.g., casual sex and multiple partners) among undergraduates.

Resenhoeft *et al.*^[36] similarly used color photographs in two different experiments to assess United States undergraduates' perception of tattooed women. Participants viewed a photograph of a woman with or without a tattoo and then rated her on 13 personality traits including attractiveness, caring, athleticism, honesty, religiosity, and intelligence. The first experiment found that a photograph of a woman with a large, visible dragon tattoo on her upper arm was perceived as less attractive, fashionable, athletic, caring, intelligent, but more creative compared to a control photograph of the same woman without a tattoo. These differences were not significant in the second experiment that used a photograph of a woman with a smaller, less visible tattoo of a pair of dolphins, with the exception of higher ratings of honesty and religiosity for the non-tattooed control. Although the study findings may have been influenced by using photos of different women dressed in different clothes in the two experiments, the results again seem to indicate negative biases against women with tattoos, even among young college students who might be expected to be more accepting of tattoos.

In an attempt to examine the impact of tattoos on sexual attraction between genders, Wohlrab *et al.*^[37] performed an experiment using computer generated virtual images depicting both women and men wearing bathing suits that revealed tribal tattoos in various locations. German university students ($n = 278$) were asked to rate these images on measures of attractiveness, dominance, aggression, masculinity or femininity, and health. In this study, images of tattooed women were rated as less healthy than women without tattoos, whereas images of men were rated as more dominant than those without. Sex differences among raters were important, with men rating images of women with tattoos as more attractive, while women rated them as more dominant. Conclusions about these findings may be limited to heterosexual perceptions of tribal tattoos among young people, but when considered along with other studies, they support the possibility that ratings of female attractiveness by men reflect biases about tattoos signaling sexual availability.

This conclusion was reinforced by a study performed in France using real women who were rated as highly attractive and who, under experimental conditions, displayed a temporary butterfly tattoo on their lower back while lying on a beach in a swimsuit. The field experiment measured how long it took for anonymous men to approach them^[38]. Compared to non-tattooed controls, women with tattoos were more likely to be approached by men and were approached within a shorter time. Subsequent interviews with the men revealed that although tattooed women were not rated as more attractive compared to controls, men gave higher probability estimates of being able to get a date with a tattooed woman and to have sex on the first encounter.

Drawing firm conclusions based on these studies is difficult, given that each utilized different methodologies and featured different women with different clothing and different tattoos. Within-study controls suggest that tattoos in young women have the potential to be interpreted as a signal of sexual availability to young men, but across studies, and in reality, visible tattoos are only one of many aspects that might influence female attractiveness. In addition, the use of different types of tattoos across various studies highlights that different tattoos seem to carry different meanings for both wearers and observers, and cautions against overgeneralization.

Looking beyond the narrow scope of the tattoo effects on ratings of female attractiveness in young people, tattoos may have different implications in other contexts, such as within older populations or professional settings. For example, one study found that female nurses with tattoos were perceived more negatively and rated as less caring, skilled, and knowledgeable than their tattooed male colleagues^[39]. Observers' perceptions of tattoos in women are therefore influenced by a large number of variables, including setting, age, and other aspects of a woman's appearance, along with tattoo size, location, and content. While such variables are important in considering perceptions about tattoos in both men and women, the impact of such variables can be very different between genders.

CASE STUDY

As psychotherapy progressed, the value of discussing Mr. A's tattoos first emerged when the therapist asked about the tattooed faces of his children which had been embellished to appear more sinister. With prompting, Mr. A admitted that this was intended to maintain a look of stoic masculinity while still bearing reminders of his children on his body, and he agreed that this reflected a strong aversion to vulnerability. Once this was interpreted, he opened up further. The tattoo referencing fellow soldiers killed in combat, visible on the back of his neck, later proved to be a useful topic of exploration when he explained that it was placed in that location so that he would keep the reminder on his body but would not have to see it unless he wished to do so. He admitted that he felt deep, intolerable grief for the loss of these friends and used the tattoo to project this loss out onto the world because he felt incapable of dealing with it in any other way. This facilitated an actual discussion of Mr. A's grief, allowing him to share his feelings for the first time. He reported to the therapist that her interest in his tattoos and non-judgmental questioning increased his sense of a therapeutic alliance and his overall engagement in treatment for PTSD. With additional work in therapy, it appeared that for Mr. A tattooing represented a kind of outward manifestation of intellectualization as a defense that prevented others from having emotional access to the fragile and sensitive person beneath his adorned skin.

In further interpreting Mr. A's tattoos in the context of the modern literature on tattooing, his skin art can be viewed as a "human canvas" which tells the story of his childhood and subsequent formative military experiences. His tattoos overwhelmingly demonstrate dark themes of violent masculinity and pain tolerance, suggesting the need to portray an outward appearance of danger-seeking fearlessness that serves to intimidate or ward off others and that provides some insight into why he was drawn to military service. Now, as a law student and father trying to reconstruct his life with the help of psychotherapy, his tattoos represent a visual depiction of themes relevant to both his past life and present inner existence. While tattoos offer a window into the psyche, it is a window that only tells a partial story. Ultimately, tattoos represent what the patient purposefully reveals on the surface, inviting the therapist to explore that portal in order to access deeper emotions, motivations, and meanings contained within.

CONCLUSION

Over the past century in Western society, tattoos have evolved from cultural taboo to mainstream fashion. Accordingly, historical biases and pathological implications about tattoos warrant revision for present-day tattoo wearers. Although the literature to date on tattooing is informative, the available data are limited to subpopulations drawn from Western industrialized cultures and offer a narrow perspective on the interactions of other characteristics of tattoo wearers (e.g., age, ethnicity, socioeconomic status) on public perception. Clinicians are therefore cautioned against over-generalization, and are instead encouraged to explore the personal meaning associated with individual patients and their different tattoos. We suggest that as a kind of augmentation of the physical exam, doing so with individuals who are engaged in psychiatric treatment provides a valuable window to the psyche that can reveal core aspects of self-identity and hidden emotions with the potential to facilitate and enhance clinical work.

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Developmental psychopathology: A primer for clinical pediatrics

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Abstract

Developmental psychopathology (DP), broadly defined as the scientific discipline that has as its primary goal the integration of developmental science and psychopathology into a coherent approach to explanatory models for psychopathological development, has become the dominant approach in the past decade for understanding

the origins of mental disorders among children and adolescents. Hence, it is incumbent upon those working in the field of clinical pediatrics to have at least a basic understanding of its core principles of DP. This article provided such an understanding (*i.e.*, a primer) in an exposition of the four principles that are generally considered be core elements of with examples illustrative of each of the principles.

Key words: Developmental psychopathology; Developmental cascades; Developmental pathways

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Core tip: Developmental psychopathology is an expansive approach to understanding the processes and pathways to normal and abnormal development. The minireview articulated the four central principles upon which approach is based. Perhaps the most important tip which these principles point to is an expansion on the notion of developmental cascades as a way of advancing the sophistication and comprehensiveness of the understanding of developmental pathways. Namely the notion of developmental cascades proposes that early appearing problems can have effects that spread across multiple levels of functioning in a multiplicity of ways over time and thus provides a promising direction for the constructing developmental models for pathways of cascading effects.

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INTRODUCTION

Developmental psychopathology (DP), broadly

defined as the scientific discipline that has as its primary goal the integration of developmental science and psychopathology into a coherent approach to explanatory models for psychopathological development, has become the dominant approach in the past decade for understanding the origins of mental disorders among children and adolescents^[1-3]. This approach emphasizes psychobiological vulnerabilities in interplay with environmental risk factors that shape developmental processes involved in psychopathology. The importance of understanding these processes is anchored in the robust consensus among clinicians and researchers that most adult manifestations of mental disorder have their origins, if not outright symptoms presentations, prior to age 18^[3]. Hence, it is incumbent upon those working in the field of clinical pediatrics to have at least a basic understanding of the core principles of DP. The purpose of this article is to provide such an understanding (*i.e.*, a primer) on this discipline by focusing on four principles that are generally considered be core elements of DP^[3]. Readers who may be interested in a much more comprehensive exposition of DP should consult the current, authoritative multi-volume work edited by Cicchetti^[4].

The article will begin with a presentation of a more expanded definition of DP and then proceed to discuss four principles that are central to the DP model with examples illustrative of each of the principles.

DEFINITION OF DP

To reiterate, DP has as its primary goal the infusion of development into the study of psychopathology and its diagnosis and treatment. It has as its primary objective, the scientific understanding how and why, and for whom and when, processes related to psychopathology develop. In so doing it emphasizes the role of developmental and contextual processes in the origins and course of various juvenile mental disorders. This emphasis has historically distinguished DP from the disciplines of clinical and abnormal child psychology which focused on the classification of childhood mental disorders rather than the complex interplay of factors affecting the dynamic processes of abnormal development. Thus, in the DP approach, psychopathology is viewed not "as a static set of diagnostic entities but rather as the product of the failure to obtain core developmental competences, leading to a progressive veering from normal developmental trajectories and an accumulation of behavior patterns considered maladaptive in most contexts, even though at least some of these behaviors may have been adaptive in the context of deprived or harsh early environments"^[3]. Lastly, since the predominant focus is on understanding the complex interplay among biological, psychological, and contextual aspects of development, DP is by definition interdisciplinary, as it draws on findings from multiple disciplines involving the medical, biological, psychological, and sociological

sciences.

CORE PRINCIPLES OF DP

DP thus has a very broad approach and can be considered a "macroparadigm that acts as a type of framework for understanding developmental processes from multiple perspectives"^[1]. Next, we discuss four of the core principles that undergird this framework. Note that although these principles are separately discussed, they are inherently interrelated.

CONSIDERING THE NORMAL AND ABNORMAL DEVELOPMENTAL PROCESSES TOGETHER

In a nutshell, this principle posits that normal and abnormal developmental processes are mutually informative and thus should be considered together. Thus, as previously mentioned, since phenomena defined as abnormal from the DP perspective represent aberrations in normal developmental processes, knowledge of pathways and processes of normal development are essential for understanding pathology. A crucial corollary of this concept is that nearly all forms of psychopathology are best understood from a quantitative/dimensional, not a qualitative/categorical perspective. Namely, since almost no mental disorder constitutes a clearly demarcated, qualitatively distinct category (*i.e.*, a disorder is either present or absent) but rather is an extreme expression on a dimension/continuum, then processes applying to individuals near the center of the continuum are likely to apply to those at the extreme end of the continuum. Thus, psychological problems are "diagnosed" when there is evidence of deviations from the normal healthy course of development with a key issue being the determination of when and how the normal processes become disrupted and channeled into maladaptive functioning. An example of how the knowledge of normal development can inform an understanding of abnormal development such as chronic physical aggression comes from the study of the developmental origins of physical aggression^[5]. Research has shown that humans, rather than having to learn how to use physical aggression, spontaneously start such usage towards the end of the first year after birth when they have acquired the physical coordination to push, pull, hit, kick, *etc.*. This usage peaks in frequency somewhere between 2 and 4 years of age and then begins to decline. Therefore, this finding from normal development clearly indicates that in order to properly understand the small group of children (almost all male) who become chronically physically aggressive the focus needs to be on the reasons why they fail to learn alternatives to physical aggression with age rather than why physical aggression has become part of their behavioral repertoire.

Conversely, knowledge of abnormal development can also inform an understanding of normal develop-

ment for the same reason that an knowledge of normal development can inform and understanding of abnormal development. Namely, in the continuum model of abnormal development, processes that apply to individuals at the extreme end of the continuum (abnormal behavior) are likely to be applicable to those near the center of the continuum (normal behavior).

An example comes from the studies of infants and toddlers that were subject to brutal deprivation in Romanian orphanages in the 1980s of varying duration (e.g., 6 mo to 3.5 years) and subsequently adopted into high quality homes in England^[6]. Perhaps the most striking finding in these studies was an apparent 6-mo threshold in that when the deprivation lasted for 6 mo or less there was no detectable impairments in functioning across 7 domains at various follow-ups to age 11 when these children were compared to adopted children who had not experienced such savage deprivation. However, pervasive impairment was found in most children if the duration of deprivation extended beyond the 6-mo cut-off. In addition, there was also the unexpected finding of no significant dose-response effect of deprivation of ranging from 6 mo to 3.5 years. Thus, findings from the extremely abnormal circumstance of brutal deprivation uncovered what appears to be threshold relevant to normal development in that infants are relatively invulnerable during the first 6 mo of life to long-lasting impairments if their subsequent care-taking is of high quality.

In sum, DP's ultimate goal is the weaving studies of normal and abnormal development into a comprehensive synthesis.

DEVELOPMENTAL PROCESSES ARE RECIPROCAL AND TRANSACTIONAL

In contrast to a linear model of developmental processes in child factors respond to environmental factors in a static invariant manner, the DP model posits that developmental processes are almost always reciprocal and transactional in nature in that: (1) Child level factors influence environmental factors and vice versa; and (2) Such mutually reciprocating influences cause changes in both child and environmental factors. For example, in a child with Attention-Deficit/Hyperactivity Disorder, impulsivity greatly increases the risk for eliciting coercive, oppositional interchanges with significant others in the child's life. Indeed, it is estimated that a typical child with ADHD has an astonishing half a million of these negative interchanges each year. This change in the environment in turn has a reciprocal influence on the child's behavior in that there is an acceleration of the use by the child of aversive behaviors to attain access to rewarding resources and to reduce unpleasant experiences. These reciprocal and transactional processes can result in a developmental cascade which refers to the cumulative consequences for development of the many reciprocal and transactional processes that result in spreading effects across many child level and

environmental level factors. Developmental cascades can explain why some problems in children (particularly conduct problems) can cause widespread difficulties in adulthood^[7].

DEVELOPMENTAL PATHWAYS

Since psychopathology is conceptualized as resulting over time from reciprocal and transactional processes that result in successive and changing pattern of maladaptation of the juvenile in relationship to their environment, the articulation of developmental pathways is "at the heart of the DP perspective"^[1]. A developmental pathway refers to a sequence and timing of behavioral continuities and transformations across development with individuals differing in their propensity to progress along the successive behavior represented by the pathway. Progress along the pathway is probabilistic, not deterministic^[8]. Although change is seen as always possible because of the dynamic nature of developmental processes, there is likely to be continuity and stability in maladaptive behavior because past structures and organizations in the individual and the transactional processes surrounding constrain change. The resultant stability in highly similar overt behaviors over time is referred to as homotypic continuity. An example of such continuity would be the depressed, withdrawn, fearful behavior of a maltreated child who continues to be reared in an abusive environment. However, in many cases the specific behavioral manifestations will change but there is continuity and stability at the level of an underlying trait. This process is termed heterotypic continuity. For example, in a case of youth on an early onset pathway for antisocial behavior, the initial manifestations are likely to be tantrums and non-compliance in preschool, followed by impulsivity and aggression during childhood; a variety of covert (e.g., theft) and overt (violence) antisocial behaviors including substance abuse problems and delinquency; and criminality in adulthood. Thus, seemingly disparate behaviors are different manifestations on a continuous antisocial pathway.

Lastly, a corollary of the developmental pathway principle is the concept of multiple pathways and outcomes. That is, multiple pathways can lead to the same development outcome (equifinality); and a given risk factor can cause multiple different outcomes (multifinality). An example of equifinality would be aggressive behavior which can have multiple different causes such as maltreatment, traumatic brain injury, a heritable tendency to impulsive, disinhibited behavior, and prenatal and perinatal risk factors^[9]. An example of multifinality would ADHD which poses a significant risk for multiple adverse outcomes such as criminality, substance abuse, academic and occupational failure^[10].

MULTIPLE LEVELS OF ANALYSIS

Following directly from the preceding principles, the last principle to be considered posits that a comprehensive

understanding of the developmental processes and pathway involved in the origins and maintenance of psychopathology requires a simultaneous analysis on multiple levels ranging from the neurobiological (e.g., neural systems) to the individual (e.g., temperament) and to all the contexts in which the individual is embedded (e.g., family, school, social). Needless to say, the implementation of this principle for any particular pathology is in its infancy, with perhaps the best example of this principle being the ontogenic process model of antisocial behavior articulated by Beauchaine and colleagues^[11-13]. In this model the biologically based temperamental trait of impulsivity, expressed early in life as the hyperactive/impulsive and combined presentations of ADHD, is conceptualized as a vulnerability to the development of antisocial behavior. The neurobiological substrate of this trait is a hypo-responsive mesolimbic dopamine (DA) system caused by chronically low levels of dopamine and diminished DA reactivity to rewards. In turn, this dysfunction provokes psychological states (irritability, discontentment) that motivate excessive impulsive reward-seeking behaviors that temporarily upregulate DA hypo-responsivity. This vulnerability elicits and interacts with various environment risk factors (e.g., aversive family and social interactions, school failure) leading to a developmental pathway of increasingly more severe antisocial behaviors.

CONCLUSION AND FUTURE DIRECTIONS

DP is an expansive approach to understanding the processes and pathways to normal and abnormal development. The preceding discussion, which articulated the four central principles upon which approach is based, also provides the basis for future directions of DP. Perhaps the most important direction which these principles point to is an expansion on the notion of developmental cascades as a way of advancing the sophistication and comprehensiveness of the understanding of developmental pathways^[1]. As previously discussed, the notion of developmental cascades proposes that early appearing problems can have effects that spread across multiple levels of

functioning in a multiplicity of ways over time and thus provides a promising direction for the constructing developmental models for pathways of cascading effects.

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Taking care of suicidal patients with new technologies and reaching-out means in the post-discharge period

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Abstract

Suicide is a global public health problem with over one million people dying by suicide each year worldwide. Research efforts have focused on developing and testing novel suicide prevention strategies employing recent technological advances. In order to provide a review regarding the role of new technologies (*e.g.*, postcards/letters, text messages, crisis cards, telephone contacts, online interventions) in suicide prevention, we searched PubMed, ScienceDirect, ResearchGate, and Crisis to identify all papers in English from 1977 to 2016. Our results indicated that brief contact interventions show promise in reducing the number of episodes of repeated self-harm and/or suicide attempts following discharge from the Emergency Department or psychiatric units. Innovative methods of contact (*e.g.*, text messages) are easily implemented by clinicians and received by patients in the period of post discharge and have been shown to be beneficial. However, more research employing randomized clinical trials investigating the potential benefits of these novel suicide prevention methods is warranted. Future researchers should continue improving and testing new technologies in the prevention of suicide.

Key words: Suicide; Letters; Postcards; Emails; Sms; Telephone

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Core tip: Several studies have shown that several reaching-out means (*e.g.*, letters, postcards, sms, emails)

are useful and beneficial for healthcare professionals in preventing suicide and self-harm attempts. In this review we wanted to evaluate how these means could influence the number of episodes of repeated self-harm and/or suicide attempts after discharge from emergency department or psychiatric wards. We have shown that these innovative methods of contact are well accepted by patients in the post-discharge period and are easily used in preventing suicide and self-harm reattempts even though future researchers should continue improving and testing new technologies in the prevention of suicide.

Falcone G, Nardella A, Lamis DA, Erbuto D, Girardi P, Pompili M. Taking care of suicidal patients with new technologies and reaching-out means in the post-discharge period. *World J Psychiatr* 2017; 7(3): 163-176 Available from: URL: <http://www.wjgnet.com/2220-3206/full/v7/i3/163.htm> DOI: <http://dx.doi.org/10.5498/wjp.v7.i3.163>

INTRODUCTION

Suicide is a severe public health problem with more than one million deaths reported per year internationally^[1]. Moreover, suicide ranks among the ten major causes of death worldwide and it is a leading cause of death among youth and young adults in many countries^[2-5]. Individuals who have been admitted to psychiatric inpatient units are at a particularly high risk for suicide^[6-8]. For these patients, the highest risk period for a relapse is immediately following discharge^[9-20]. Cutcliffe *et al.*^[21] aimed to understand why this time period has been identified as the highest risk. In their study, participants indicated a sense of feeling lost, disorientated, and uncertain after discharge. Some patients reported feeling "disoriented" in their daily lives. Accordingly, there is significant usefulness in making a post-discharge treatment plan in collaboration with the client, which can subsequently explore pragmatic issues such as "what will I have to do next?", "what issues must I face first?", and "where will I seek help?"

Some patients recognize an increased risk of reattempt following discharge because they become lonely when they return home. Indeed, patients recognize the need to interact with individuals (patients and staff) while on the unit. Even the mere presence of other patients and health care professionals is beneficial to those who have attempted suicide and need support. The hospitalization of a patient following a suicide attempt may be considered the first step in a long prevention strategy. It is critical that mental health professionals acknowledge that a substantial portion of recovery in suicidal patients occurs at the end of the acute period especially when they prepare for discharge and in the post-discharge period. Beautrais^[22] observed that for many patients who have attempted suicide, the situation has not changed following a suicide attempt because they do not receive the help they need. Patients

who are discharged post-suicide attempt often encounter barriers during their recovery and may seriously consider suicide and/or make another attempt. Also, these patients often want to start over, but do not know where to begin, do not know what to do, and frequently do not know who to ask for help solving their problems. Individuals who have received some form of aid in the post-discharge period consider this a form of security. According to Cutcliffe *et al.*^[21], this kind of help is more useful when it is offered by mental health professionals. Moreover, it turns out to be very useful to the patient and professional(s) develop a treatment plan collaboratively, which includes determining which support method should be employed (e.g., telephone calls, e-mails, letters, SMS, etc.) immediately following discharge.

There is the need for the suicidology community to perhaps revisit what should be considered an appropriate timeframe for managing suicidality. In such a model, clinicians and researchers would acknowledge that the majority of the rehabilitation work for reducing suicide risk is likely to be undertaken in post-discharge period. All suicides and suicide attempts affect others, particularly "survivors", such as spouses, parents, children, relatives, friends, colleagues, and peers of those who have made a suicidal gesture, both immediately and in the long term. Suicide represents a major challenge for health care providers and society as a whole, especially in terms of prevention. New technologies have entered the field of suicide prevention with high expectations for the future, despite a relatively slow start.

Over the last decade, the internet has played an increasingly influential role in people's lives, particularly among young adults in middle and high income countries. Internet users now access the social media platforms to create, exchange and share their own content and experiences^[23,24]. The Internet, mobile phones and self-help programs have the strong potential to achieve, sustain and help people who attempt suicide, their families, health professionals, and the suicide survivors. Globally, the use of new technologies have been demonstrated to be a useful and easily applicable approach to suicide prevention, which can be implemented by volunteers and professionals, from crisis lines, suicide prevention centers, mental health centers, researchers, and politicians^[25].

The aim of the present review is to understand the role of new technologies for reducing self-harm, suicide attempt, and death by suicide, while paying particular attention to post-discharge from an Emergency Department (ED) or Psychiatric Ward. We also assess usability, validity, and effectiveness of letters, text messages, crisis cards, telephone contacts, and online interventions compared to current prevention techniques.

MAIN OUTCOME MEASURES

The primary outcomes considered in this review were: (1) The occurrence of any subsequent episode of self-

harm and/or suicide attempt post-discharge; (2) The number of repeated episodes of self-harm and/or attempted suicide per person post-discharge; and (3) the total number of suicide deaths.

POSTCARD/LETTERS/CRISIS CARD/ GREEN CARD

Motto *et al.*^[26] assessed the efficacy of a long-term contact program on the prevention of suicide. They randomly divided 843 patients hospitalized because of a depressive episode and/or suicidal state who had declined or discontinued treatment during the last 30 d (a total of 3005 individuals were contacted 30 d after discharge about follow-up treatment). Patients in the experimental group ($n = 389$) were contacted through a short letter correspondence for five years. The schedule for these contacts was sent monthly for four months, then every two months for eight months, and finally every three months for four years (a total of 24 letters for five years). The control group ($n = 454$) received no further contact. The authors found that patients in the intervention group had a lower suicide rate across all five years as compared to the control group, suggesting a preventative influence of the contacts. Conversely, reducing and/or discontinuing contacts may decrease and eventually eliminate this effect.

Hassanian-Moghaddam *et al.*^[27,28] conducted a RCT to evaluate the efficacy of a postcard intervention plus treatment as usual (TAU) vs TAU of three primary outcomes: suicidal ideation, suicide attempts, and self-cutting (or self mutilation) in a follow up of 12 and 24 mo in two separate studies. They sent nine postcards over 12-24 mo to 1150 patients discharged from the Lohman-Hakim Poison Hospital. Eight postcards were sent at 1, 2, 3, 4, 6, 8, 10 and 12 mo after discharge. In the second study, a postcard was also sent 24 mo after discharge. Each participant received a ninth postcard on his birthday, with the other 1150 patients receiving TAU. The researchers found that suicidal ideation and suicide attempts were reduced by a postcard intervention. Specifically, there was a beneficial effect on suicidality during the 12-24 mo follow-up period.

Carter *et al.*^[29] conducted a RCT to evaluate the effectiveness of an intervention using postcards (postcards from Edge project) in reducing repetitions of hospital treated deliberate self-poisoning in a follow up period of 1^[29], 2^[30] and 5 years^[31]. Participants ($n = 772$) were randomized into an intervention group ($n = 378$) and a control group ($n = 394$). The intervention group received a postcard at 1, 2, 3, 4, 6, 8, 10 and 12 mo after discharge from the toxicology service with deliberate self-poisoning. The rate of hospital-treated-self-poisoning events was reduced by 50% over a 1-year, 2-years and 5-years period through the use of a postcard intervention, although it did not significantly reduce the proportion of individuals who repeated self-poisoning.

Beautrais *et al.*^[32] conducted a RCT to determine if a postcard intervention reduced repeated self-harm in persons aged 16 and older, who admitted to psychiatric emergency services at Christchurch Hospital, New Zealand, following self-harm or attempted suicide. Participants ($n = 327$) were randomized into two groups, one of which ($n = 174$) received TAU; whereas, the other ($n = 153$) received TAU plus the postcard intervention. The postcard intervention consisted of a set of six "postcards" sent by mail during the 12 mo following discharge at 2 and 6 wk; 3, 6, 9 and 12 mo. No significant differences were found between the control and intervention groups with regards to the proportion of participants re-presenting with self-harm to the psychiatric emergency department, ED, or to either the psychiatric emergency or ED. Moreover, the use of this intervention had not shown a reduction in the total number of re-presentations for self-harm to the ED or to either the psychiatric emergency service or the ED. However, a reduction in the total number of re-presentations to the psychiatric emergency service was associated with postcard intervention, although the significance of this effect must be considered marginal given that the significance level exceeded the adjusted boundary P value.

Evans *et al.*^[33] conducted a RCT to evaluate, through a follow-up of 6 mo^[33] and 12 mo^[34], the usefulness of crisis cards in the repetition of a self-harming group of hospital-admitted patients. In the RCT, the researchers recruited 827 patients admitted to hospital following self-harm. Approximately half of the study participants received a card crisis while all others received standard treatment. In addition to treatment as usual, the intervention group was offered telephone support should any further crises arise. The main outcome assessed in this study was represented by repetition of deliberate self-harm within 6 mo and 12 mo of the index event. At 6-mo follow-up, the authors had shown that sending a card offering 24-h crisis telephone consultation is not effective on the repetition of self-harm. However, among those presenting following a first episode, a possible benefit was reported. At 12 mo follow up, the results confirmed no overall benefit of the intervention. Among those with a first episode of self-harm, the possible benefit of the intervention had diminished although only a modest effect was detected.

Cotgrove *et al.*^[35] evaluated the usefulness of an intervention for the prevention of suicide reattempts using green cards in adolescents 16 years of age or younger who were discharged from the hospital following a suicide attempt. After discharge, these adolescents were randomized into an experimental ($n = 47$) and a control group ($n = 58$). A green card which served as a passport to readmission into a pediatric ward at their local hospital was sent to the participants in the experimental group. If adolescents felt suicidal, they would be able to obtain immediate admission to the hospital. Adolescents in the control group received

standard treatment from their clinic or child psychiatric department. For one year after the suicide attempt, information was collected through green cards. In the year of follow up, only 3 (6%) patients in the experimental group made a suicide attempt and 5 (11%) made use of their green cards; whereas, in the control group, 7 (12%) attempted suicide. Although the repeat rate for those without green cards was twice that of those with green cards (12% vs 6%), this difference did not reach statistical significance ($P = 0.26$). It was observed that adolescents used the green card properly, considering it as a solution to their problems, knowing that they could be hospitalized if necessary.

LETTERS AND TELEPHONE CONTACT

Mouaffak *et al*^[36] developed a follow-up intervention program called the organization of a suitable monitoring for suicide attempters (OSTA), which aimed to test the efficacy of a 1-year RCT. In this study individuals ($n = 320$) admitted to the psychiatric ED and the Psychiatric Department of the University Hospital of Bicêtre, France, were randomly assigned to receive either the OSTA program ($n = 160$) or a control treatment ($n = 160$). On an intention to treat basis, the proportion of patients who reattempted suicide did not differ significantly at 12 mo, between the intervention arm and the control arm. There was also a nonsignificant difference found between the two groups in the number of suicide attempts in the intervention vs the control group. For the repeaters, the percentage of those who have attempted suicide in the experimental group is only slightly higher than that of the control group (23.4% vs 23.3%).

Kapur *et al*^[37] carried out a pilot RCT to evaluate if periodic contact after an act of self-injury can influence self-destructive behavior. Participants were admitted to the ED after self-harm and then randomized to the control ($n = 33$) or intervention group ($n = 33$). The intervention included an information leaflet listing sources of help, two telephone calls during the first 2 wk, and letters sent at 1, 2, 4, 6, 8 and 12 mo. After 12 mo, the rate of repetition of self-harm behavior was higher in the intervention group than control group.

TELEPHONE CONTACT

De Leo *et al*^[38] conducted a study that showed encouraging results regarding the use of telephone contact to reduce suicidal behavior. The researchers compared the suicide rate between people connected to the service and the general population in the Veneto region of Italy. Tele-Help/Tele-Check included both an active help system to call and a service that provided a phone call about twice a week. During the 4 years of follow up, only one death by suicide was reported in the intervention group compared with the expected value of 7.44 for the general population. This study was replicated by De Leo *et al*^[39], which evaluated the

impact of telephone contact after 10 years of follow up (from 1988 to 1998). Only 6 deaths by suicide occurred during this time period, which were less than expected ($n = 20.86$) and confirmed the benefit of the Tele-Help/Tele-Check service.

Cedereke *et al*^[40] conducted a randomized controlled trial to determine if telephone contacts can have an effect on suicidal behavior after a suicide attempt. Patients ($n = 107$) received a telephone call at 4 and 8 mo following discharge from a Medical Emergency Inpatient Unit and 109 subjects did not receive the intervention. Two suicide deaths occurred during the 12 mo-follow up: One woman belonging to the intervention group and one man belonging to the control group. There were no significant differences in subjects who died by suicide: 14 subjects in the intervention group (17%) and 15 in the control group (17%).

Vaiva *et al*^[41] conducted a randomized controlled trial in order to demonstrate that a telephone call can reduce numbers of reattempted suicide. Subjects discharged from the ED after a suicide attempt by drug overdose were randomly assigned to three different groups: One group received telephone contact at one month; another group received telephone contact at three months and the last group did not receive any telephone contact (control group). Numbers of reattempted suicides was significantly lower in the group that received a telephone call after one month than the control group (12% vs 22%). For people contacted at three months, the difference was not significantly lower than control group (17% vs 22%).

Fleischmann *et al*^[42] recruited 1867 suicide attempters from emergency departments at 5 different countries: (Brazil, India, Sri Lanka, Islamic Republic of Iran, China) and conducted a RCT to investigate the role of periodic contact on suicidal behavior. All participants were randomly assigned to receive 1 h of brief intervention as close to the time of discharge as possible and nine follow-up contacts after discharge or to receive only treatment of somatic symptoms related to a suicide attempt (control group receiving treatment as usual - TAU). The primary outcome measure was the number of deaths by suicide. At 18-mo follow-up, 18 participants (2%) in the control group died by suicide vs 2 subjects (0.2%) in the intervention group.

Bertolote *et al*^[43], starting from the RCT of Fleischmann *et al*^[42], evaluated rates of repeated suicide attempts as the secondary outcome during 18-mo of follow up. No significant difference between the two groups was shown in the results of this study. This result did not confirm the encouraging reduction of suicide mortality previously demonstrated by Fleischmann *et al*^[42].

Cebrià *et al*^[44] conducted a case-control study to evaluate the efficacy of a telephone contact program. Patients discharged from the ED following a suicide attempt were included. Participants of the intervention group ($n = 296$) received a telephone call after 1 wk, thereafter at 1, 3, 6, 9 and 12-mo intervals.

The patients in the control group ($n = 218$) received treatment as usual without additional telephone contact during 1-year follow-up. Results showed that the telephone contact program was associated with a low rate of patients who reattempted suicide compared to the previous year and to the control population. The telephone management program also delayed suicide reattempts in the intervention group compared the control population. Cebria *et al.*^[45] called all the participants in the previous study again after 5 years in order to evaluate the benefit of telephone contact on the suicidal behavior over the long term. There was not a statistically significant difference in the number of people who reattempted suicide after 5 years (intervention group: 31.4% vs control group: 34.4%). This result suggests that telephone contact after a suicide attempt was effective after one year, but this benefit was not maintained after 5 years.

Amadéo *et al.*^[46] conducted a RCT to test the efficacy of brief intervention and telephone contact after a suicide attempt. Two hundred patients admitted to the ED for self-harm behaviors were randomly assigned to the control group ($n = 100$) or to the intervention group ($n = 100$). Participants of the control group received treatment as usual. Patients in the intervention group received care as usual plus one hour of information session and 9 telephone contacts at 1, 2, 4, 7 and 11 wk and at 4, 6, 12 and 18 mo. It was found no significant difference in the frequency of suicidal behavior between the two groups. Two deaths by suicide occurred in the control group vs none in the intervention group.

TELEPHONE, EMAIL, TEXT MESSAGE, LETTERS

Hvid *et al.*^[47] conducted a quasi-experimental prospective design study to evaluate the utility and efficacy of a Baerum-model like intervention after attempted suicide. The Baerum model is a form of cooperation between Baerum hospital and the municipal health services in Asker and Bærum municipalities. The Bærum model consists of four stages: Medical treatment and monitoring; psychosocial/psychiatric intervention; aftercare by a public health nurse; continued residential or non-residential treatment. In this prospective study, patients who attempted suicide (intervention group; $n = 93$) were provided follow-up care by a program offering home visits and contacts. The patient identified a primary contact while in the hospital and follow-up visits were conducted after discharge by personal contact, telephone calls, letters, text messaging and e-mails. A control group ($n = 58$) received TAU, which included a psychiatric assessment followed by a decision on whether to offer the patient psychiatric treatment. Results revealed a significantly lower repetition rate in the intervention group; the proportion of repetitive patients fell from 34% to 14%. There were also fewer suicidal acts, in total 37 acts in the control group and 22 acts in intervention group.

The Baerum model like intervention has a good chance of being a suicide prevention intervention of high acceptability and adherence, and was found to have acceptable effectiveness in the follow-up period of 1 year. As Hvid *et al.*^[48] have found encouraging results from the previous quasi-experimental prospective study conducted on the Baerum model, they decided to assess this model also through an RCT. They decided to evaluate the above-mentioned model based on the same model of intervention to assess it on the prevention of new suicide attempts in patients who had already made an attempt. During a two year period, 133 participants were randomized to the experimental group ($n = 69$) and they received the OPAC program and 64 to the (non-intervention) control group. The intervention in the experimental group was implemented as soon as possible following the suicide attempt. In the intervention group was observed a significantly lower proportion (proportion 8.7%) of patients who repeated a suicide attempt than in the control group (proportion 21.9%). Also the number of repetitive acts was significantly lower (8 repetitions in the intervention group vs 22 in the control group) (Table 1).

DISCUSSION

The present review sought to shed light on the role of new technologies as a means of preventing suicide in patients discharged from EDs and/or psychiatric wards. A systematic and meta-analytic review was conducted by Milner *et al.*^[49] to synthesize the evidence regarding the efficacy in reducing self-harm, suicide attempt and suicide deaths of brief contact interventions (*e.g.*, letters, green cards, telephone calls and postcards). However, unlike our study, Miller and colleagues did not focus on the evaluation of these means of prevention in the post discharge from an ED or psychiatric ward. Although the results of this review demonstrated how brief contact interventions have had a significant effect on the number of episodes of repeated self-harm or suicide attempts, these brief contact interventions cannot yet be recommended for widespread clinical implementation.

Based on the main findings of the present review, different types of new technologies have been used and evaluated in several studies as a means of suicide prevention. From this review, 10 studies examined the role of postcards, letters, crisis cards/green cards, 9 studies investigated the role of telephones, 2 studies the role of the telephones and letters (simultaneously) and 2 assessed the role of the telephones, letters, and text messages (simultaneously).

Regarding studies based on the use of postcard/crisis card/green card as a means of suicide prevention, only three of these studies have shown that these means may reduce the rate of suicide^[26] and suicide ideation^[27,28] in the experimental group to follow up. The other seven studies found that the intervention does not

Table 1 Summary of studies reporting contact with patients involving new technologies and reaching-out means in the post-discharge period

Ref.	Study design	Sample	Criteria	Methods	Outcomes	Follow-up	Results
Postcard/ letters/crisis card/green card Motto <i>et al</i> ^[26] , RCT 2001		843 participants	843 patients who had refused ongoing care after hospitalization because of a depressive or suicidal state	843 patients randomized to Intervention group: (<i>n</i> = 389) contacted by short letter for five years (a total of 24 letters for five years); control group: (<i>n</i> = 454) received no contact	Suicide rate	5 yr (contact period) and 10 yr	Patients in the contact group had a lower suicide rate in all five years of the study Intervention group: Suicide rate: 0.77% Control group: Suicide rate: 1.32% only for the first two years (<i>P</i> value = 0.043). Differences gradually decreased and at 15-yr no differences were observed
Hassanian- Moghaddam <i>et al</i> ^[27] , 2011	RCT	2300 participants	Subjects admitted to the Loghman- Hakim Poison Hospital from March to June 2006, above 12 yr of age with self- poisoning defined by exclusion of poisoning classified as recreational, habitual misuse, accidental or iatrogenic by the treating medical toxicologist	2300 patients randomized to Intervention group: (<i>n</i> = 1150) received nine postcards sent over 12 mo. Eight postcards are mailed at 1, 2, 3, 4, 6, 8, 10 and 12 mo after discharge. A ninth postcard is sent for each participant's birthday Control group: (<i>n</i> = 1150) received no contact	Suicidal ideation; suicide attempt; cutting or self- mutilation; deaths	12 mo	A postcard intervention reduced suicidal ideation and suicide attempts. Sustained, brief contact by mail may reduce suicidal ideation and suicide attempts in individuals who self-poison Suicidal ideation: Intervention group: 29.0%. Control group: 41.7% Relative risk reduction: 0.31 (0.22 to 0.38). Number needed to treat: 7.9 (6.0 to 11.5) Suicide attempt: Intervention group: 3.0%. Control group: 5.1% Relative risk reduction 0.42 (0.11 to 0.63). Number needed to treat 46.1 (26 to 203.7) Self-cutting: Intervention group: 4.0%. Control group: 4.7% Relative risk reduction 0.14 (-0.29 to 0.42) Number needed to treat NA
Hassanian- Moghaddam <i>et al</i> ^[28] , 2017						24 mo	There was a beneficial effect demonstrated for suicidal ideation and suicide attempt during the 24 mo follow-up period (after cessation of the intervention), however, there was no effect on self-cutting behavior during the same period Suicidal ideation: Intervention group: 46.6%. Control group: 58.6% ARR: 11.93% (95%CI: 7.58-16.27), OR: 0.62 (95%CI: 0.52-0.74) Suicide attempt: Intervention group: 6.2%; control group: 9.1% ARR: 2.85% (95%CI: 0.52-5.17), OR: 0.67 (95%CI: 0.48-0.93) Self-cutting: Intervention group: 1.5%; control group: 1.5% ARR: 0.00% (95%CI: -0.01-0.01), OR: 1.01 (0.49-2.07)

Carter <i>et al</i> ^[29] , 2005	RCT	772 participants	Participants (> 16 yr) presented to the toxicology service with deliberate self poisoning from April 1998 to December 2001	772 patients randomized To Intervention group: (<i>n</i> = 378) received a postcard at 1, 2, 3, 4, 6, 8, 10 and 12 mo after discharge Control group: (<i>n</i> = 394) received no contact after discharge	Proportion of patients who repeat episodes of deliberate self poisoning; the number of repeat episodes of deliberate self poisoning per person	12 mo	A postcard intervention reduced repetitions of deliberate self poisoning, although it did not significantly reduce the proportion of individual repeaters Proportion of patients who repeated episode of self poisoning: Intervention group: 15.1%; control group: 17.3% N° of repeat episodes: Intervention group: 101; control group: 192 Incidence risk ratio of repetition: Intervention group: 0.55 <i>vs</i> Control group: 1.00 [ES = 0.13 (CI: 0.35 to 0.87); <i>P</i> value = 0.010]
Carter <i>et al</i> ^[30] , 2007					Proportion of patients who repeat episodes of deliberate self poisoning; number of repeat admissions	24 mo	A postcard intervention maintained the halving of the rate of hospital-treated-self-poisoning events over 2-yr period, although it did not significantly reduce Proportion of patients who repeated episode of self poisoning: Intervention group: 21.2%; control group: 22.8% N° of readmissions: Intervention group: 145. Control group: 310 Incidence risk ratio of repetition: Intervention group: 0.49; control group: 1.00 [ES = 0.10 (CI: 0.33 to 0.73); <i>P</i> value = 0.010] The treatment was effective only for women: Intervention group: 0.49; control group: 1.00 [ES = 0.12 (CI: 0.30 to 0.80); <i>P</i> value = 0.004]
Carter <i>et al</i> ^[31] , 2013					Proportion of patients who repeat episodes of deliberate self poisoning; number of repeat admissions; proportion of patients admitted to the hospital for any psychiatric reason; number of readmissions to a psychiatric hospital; all-cause mortality; suicide deaths	5 yr	A postcard intervention halved self-poisoning events and reduced psychiatric admissions by a third after 5 yr Proportion of patients who repeat episodes of deliberate self poisoning: Intervention group: 24.9%. Control group: 27.2% Number of repeat admissions: Intervention group: 252; control group: 484 Incidence risk ratio of readmission: Intervention group: 0.54; control group: 1.00 (CI: 0.37 to 0.81; <i>P</i> value < 0.01) The treatment was effective only for women: Intervention group: 0.55; control group: 1.00 [CI: 0.34 to 0.88]; <i>P</i> value = 0.01] Proportion of patients admitted to the hospital for any psychiatric reason: Intervention group: 38.1%. Control group: 35.5% Number of readmissions to a psychiatric hospital: Intervention group: 447; control group: 710 All-cause mortality: Intervention group: 5.8%; control group: 5.6% Suicide deaths: Intervention group: 1.3%. Control group: 1.5%

Beautrais <i>et al</i> ^[32] , 2010	RCT	327 participants	Participants (> 16 yr) admitted to psychiatric emergency services at Christchurch Hospital, New Zealand, following self-harm or attempted suicide during the period August 1, 2006 to April 6, 2007	327 participants randomized to Intervention group: (<i>n</i> = 153) received treatment as usual + postcard intervention (six "postcards" sent by mail during the 12 mo following) Control group: (<i>n</i> = 174) received treatment as usual	Percentage of patients re-submitted at the psychiatric emergency service and at the emergency department for self-harm; numbers of self-harm re-presentations	12 mo	There were no significant differences between the control and intervention groups in the proportion of participants re-presenting with self-harm or in the total number of re-presentations for self-harm Percentage of patients re-submitted at the psychiatric emergency service and at the emergency department for self-harm: Intervention group: 25.5%; control group: 28.2% Numbers of self-harm re-presentations: Intervention group: 56.9%; control group: 78.2% (IRR 0.73; CI: 0.5-0.95; <i>P</i> value < 0.03)
Evans <i>et al</i> ^[33] , 1999	RCT	827 participants	Patients admitted to hospital following deliberate self-harm between November 1994 and July 1996	827 patients randomized to Intervention group: (<i>n</i> = 417) received the green card offering 24-h crisis telephone consultation with an on-call psychiatrist for up to 6 mo Control group: (<i>n</i> = 410) received standard treatment	Patients who repeated self-harm	6 mo	At 6 mo, there was no effectiveness of the provision of a card offering 24-h crisis telephone consultation on repetition of self-harm but there was a possible benefit among those presenting following a first episode Patients with repeated self-harm: Intervention group: 16.8%; control group: 14.4% Median time to repetition: Intervention group: 33 d; control group: 40 d Intervention with green card seemed to have a protective effect on self-harm first timers <i>vs</i> people with history of previous self-harm. First timers: 18 (OR: 0.64; 0.34-1.22) Previous history of self-harm: 52 (OR: 1.85; CI: 1.14-3.03)
Evans <i>et al</i> ^[34] , 2005						12 mo	At 12 mo there was no overall benefit of the intervention. Among those with a first episode of self-harm, the possible benefit of the intervention had diminished Patients with repeated self-harm: Intervention group: 21.6%; control group: 18.8% Median time to repetition did not differ between the two groups Among those with a first episode of self-harm, the possible benefit of the intervention had diminished compared to Evans <i>et al</i> ^[33] 1999 (OR: 0.89, CI: 0.52-1.52)
Cotgrove <i>et al</i> ^[35] , 1995	RCT	105 participants	Adolescents (aged 16 yr or under), admitted to the study hospitals between January 1987 and January 1990 for a suicide attempt (all acts of deliberate self-poisoning and deliberate self-harm are also considered)	105 participants randomized to Intervention group: (<i>n</i> = 47) received a token, a green card, which acted as a passport to re-admission into a pediatric ward in their local hospital Control group: (<i>n</i> = 58) received standard treatment	Rate of further suicide attempts; rate of the use of the token	12 mo	There were lower rates of repeat suicide attempts in the intervention group. The differences between two groups did not reach the level of statistical significance Further suicide attempts: Intervention group: 6%; control group: 12% Rate of repetition: Intervention group: 6%; control group: 12%

Letters and telephone contacts							
Mouaffak <i>et al.</i> ^[36] , 2015	RCT	320 participants	Adult subjects (men and women > 18 older) surviving a suicide attempt, discharged from the Emergency Department from January 2009 until December 2011	320 participants randomized to Intervention group: (<i>n</i> = 160) destined to OSTA program (provided a card with a telephone number of a psychiatrist available 24 h a day and telephone calls at 2 wk post discharge, at months 1 and 3) Control group: (<i>n</i> = 160) received no contact	Proportion of patients who reattempted suicide; proportion of patients who started a medical follow-up	12 mo	There were no significant differences, between the two groups, in the number of patients who reattempted suicide and in suicide attempts Proportion of patients who reattempted suicide: Intervention group: 14.5%; control group: 14% Number of suicide attempts: Intervention group: 0.2 ± 0.58 . Control group: 0.23 ± 0.84 Patients who started a medical follow-up: Intervention group: 24.2%; control group: 31%
Kapur <i>et al.</i> ^[37] , 2013	RCT	66 participants	Participants (> 18 yr), resident in Manchester, who presented to 2 of the 3 Emergency Department in the city with self-harm during November 2010 to May 2011	66 participants randomized to Intervention group: an information leaflet listing local and national sources of help mailed as soon as possible after consent, two telephone calls within the first 2 wk, and then a series of letters over a 12-mo period (at 1, 2, 4, 6, 8 and 12 mo). Control group: Received treatment as usual	Proportion of patients with at least one repeat episode of self-harm resulting in hospital attendance within 12 mo; number of repeat episodes during the same time period	12 mo	The rate of repetition of self-harm behavior was higher in the intervention group than control group. Repeat rate of self-harm over 12 mo: Intervention group: 34.4%. Control group: 12.5% (OR: 3.67, 95%CI: 1.0-13.1; <i>P</i> = 0.046) Total number of episodes of repeat self-harm over 12 mo: Intervention group: 41; control group: 7. [IRR = 5.86, 95%CI: 1.4-24.7; <i>P</i> value = 0.016] Adjusting for baseline clinical factors (centre, method of harm (self-poisoning <i>vs</i> other), previous self-harm, previous psychiatric treatment): repetition: (adjusted OR: 4.35, 95%CI: 0.9-19.8; <i>P</i> value = 0.057) repeat episodes: (adjusted IRR = 7.16, 95%CI: 1.6-32.8, <i>P</i> value = 0.011)
Telephone contact							
De Leo <i>et al.</i> ^[38] , 1995	Ecological study	12135 participants	Participants (> 65 years old) who were living in the Veneto region of Italy connected to the Tele Help/Tele-Check service from January 1, 1998 and December 31, 1998	Authors compared the rate of suicide between Tele-Help/Tele-Check users and the general population	Rate of suicide	4 yr	Only one suicide death occurred among elderly service users than expected. Ratio: 1:7.44 between observed and expected suicides. Standardized mortality ratio: ($1/7.44 \times 100\%$): 13.44% ($\chi^2 = 2.54$, <i>df</i> = 1, 95%CI: 0.3%-74.8%; <i>P</i> value < 0.05)
De Leo <i>et al.</i> ^[39] , 2002	Ecological study	18641 participants		Comparison between observed and expected suicide rates among older Tele-Help/Tele-Check users		10 yr	Significantly fewer suicide deaths occurred among elderly service users than expected. Suicide deaths: Observed <i>n</i> = 6; expected <i>n</i> = 20.86, $\chi^2 = 10.58$, <i>df</i> = 1; <i>P</i> value < 0.001 with an SMR for users of 28.8% (95%CI: 11.5-62.5)
Cedereke <i>et al.</i> ^[40] , 2002	RCT	216 participants	Patients treated after a suicide attempt at the Medical Emergency Inpatient Unit of the University	216 participants randomized to Intervention group: (<i>n</i> = 107) received telephone call at 4 and 8 mo	Attendance to treatment; repetition of suicide attempts; GAF, CSI, SSI score	12 mo	At follow-up, attendance and repetition of suicide attempts did not differ between the two groups Attendance to treatment repetition of suicide attempts: At baseline: Intervention group:

		Hospital of Lund between February 1995 and April 1997	Control group: (n = 109) destined to no such interventions			76%, Control group: 72% At follow-up: Intervention group: 72%. Control group: 65% Repetition of suicide attempts: Intervention group: 17% made 26 suicide attempts. Control group: 17% made 27 suicide attempts GAF: Intervention group: 1 st month = 50.5 ± 19.9. 12 th month = 61.4 ± 20.4 (P value < 0.001) Control group: 1 st month = 50.3 ± 21.1. 12 th month = 58.6 ± 20.2 (P value < 0.01) SSI score Intervention group: 1 st month = 7.9 ± 8.4 (P < 0.10). 12 th month = 5.8 ± 7.8 (P value < 0.05) Control group: 1 st month = 5.0 ± 6.8 (P < 0.10). 12 th month = 4.0 ± 6.2 (P value < 0.05) SCL90-GSI Intervention group: 1 st month = 1.05 ± 0.74. 12 th month = 0.82 ± 0.78 (P value < 0.05) Control group: 1 st month = 1.02 ± 0.77. 12 th month = 0.88 ± 0.72
Vaiva <i>et al</i> ^[41] , RCT 2006	605 participants	People (18-65 yr) discharged from an emergency department after attempted suicide by deliberate self poisoning	605 participants randomized to Intervention group: (n = 147) received telephone contact at one month after a suicide attempt Intervention group: (n = 146) received telephone contact at three months Control group: (n = 312) without telephone intervention	Proportion of participants who reattempted number of deaths by suicide and losses to follow up at 13 mo	13 mo	For participants contacted at one month, the number of who reattempted suicide is significantly lower than that of controls. For participants contacted at three months, the number who attempted suicide was not significantly lower than that of control Proportion of participants who reattempted suicide: At 1 mo: Intervention groups: 16%. Control group: 19% At 3 mo: Intervention group: 14%. Control group: 19% Number of deaths by suicide: At 1 mo: Intervention group: 0 %. Control group: 1% At 3 mo: Intervention group: 1%. Control group: 1% Lost to follow up: At 1 mo: Intervention group: 7%. Control group: 10% At 3 mo: Intervention group: 10%. Control group: 10% Significantly fewer suicide deaths occurred in the intervention group than in the control group. Suicide deaths: Intervention group: 0.2%. Control group: 2.2% (P value < 0.001)
Fleischmann <i>et al</i> ^[42] , 2008 RCT	1867 participants	Suicide attempters identified by medical staff in the emergency units of eight collaborating hospitals in five different countries	1867 participants randomized Intervention group: (n = 922) received treatment as usual plus brief intervention and contact (which provided a standard 1-h individual information session combined with periodic follow-up phone calls or visit) Control group: (n = 945) received treatment as usual	Deaths from suicide	18 mo	

Bertolote <i>et al</i> ^[43] , 2010					Repeated suicide attempts		At follow up, repeated suicide attempts did not differ between the two groups. Repeated suicide attempts: Intervention group: 7.6%. Control group: 7.5%
Cebrià <i>et al</i> ^[44] , 2013	Case-control study	991 participants	Patients without age limit treated for attempted suicide during the years 2007-2008. They were identified following a systematic review of electronic medical records of the emergency departments of psychiatry, medicine, traumatology, surgery and pediatrics in the area of Sabadell	991 participants randomized to Intervention group: (n = 604) received telephone call for 1-yr after discharge from Emergency Department for suicide attempt Control group: (n = 387) received treatment as usual	Days to first reattempt; rate of patients who reattempted suicide	12 mo	The rate of patients who reattempted suicide was lower in the intervention group compared to the previous year Mean time in days to first reattempt Intervention group: Baseline: 316.64; Intervention year: 346.47 (Baseline <i>vs</i> intervention years log rank <i>P</i> value < 0.0005) Control group: Baseline: 273.05; Intervention year: 300.36 Intervention group <i>vs</i> control group during the intervention year (respectively 346.47 <i>vs</i> 300.36; log rank <i>P</i> value < 0.0005) Rate of patients who reattempted suicide Intervention group: Baseline: 14%; Intervention year: 6% (Baseline <i>vs</i> intervention years log rank <i>P</i> value < 0.0005) Control group: Baseline: 21%; Intervention year: 14% Intervention group <i>vs</i> control group during the intervention year (respectively 6% <i>vs</i> 14%; log rank <i>P</i> value = 0.005)
Cebrià <i>et al</i> ^[45] , 2015	Nonrandomized, controlled, parallel study	514 participants		All participants (Cebrià <i>et al</i> ^[45] 2013) were called after 5 yr	Rate of reattempts; time to recurrence	5 yr	There was a reduction of the rate of reattempts in the first year. The effects of the intervention was not be maintained at 5 yr Rate of reattempts Intervention group: 0.864. Control group: 0.839 Time to recurrence Intervention group: 1429 d. Control group: 1332 d
Amadéo <i>et al</i> ^[46] , 2015	RCT	200 participants	Participants admitted to the Emergency Department of the Centre Hospitalier de Polynésie Française for intentional self harm over the period 2008-2010. All patients included in this study had a short psychiatric hospitalization (minimum 24 h)	200 patients Randomized to Intervention group: (n = 100) received treatment as usual plus brief intervention and contact (which provided nine follow-up phone calls Control group: (n = 100) received treatment as usual	Number of suicides and repeated non-fatal suicidal behavior	18 mo	There were a reduction in the number of suicides and episodes of non-fatal suicide behaviour in the intervention group Episodes of non-fatal suicide behaviour: Intervention group: 26.7% <i>vs</i> Control group: 21% Suicide: Intervention group: 0% <i>vs</i> Control group: 2.0%
Hvid <i>et al</i> ^[47] , 2009	Cohort study	151 participants	Participants arrived at the hospital's emergency rooms and clinical departments of	151 participants are randomized to Intervention group: Cohort of 2004 (n = 93) received a primary	Participation by acceptance and adherence;	1 yr	There were a significant lower repetition rate and fewer suicidal acts in the intervention group. The programme had a high acceptability Acceptability:

Telephone,
e-mail, text
message,
letters

			Copenhagen University Hospital Amager for attempted suicide and self-harm actions through spring 2002 and spring 2004	contact while the patient was in hospital and followed-up visits (8) after hospital discharge, by personal contact, telephone calls, letters, text messaging and emails. The intervention period was limited to 6 mo	repetition of suicide attempt and suicide; number of repetitive acts in 1 yr after the attempted suicide episode		65 of 94 patients of the Cohort of 2004 remained in the programme (70% participation) Repetitions during 1 yr: Cohort of 2002: 18 repetitive patients and 1 suicide (32.8%) 37 repetitive acts Cohort of 2004: 12 repetitive patients and 1 suicide (13.9%), 22 repetitive acts RR = 0.427 (95% CI: 0.228-0.797)
Hvid <i>et al.</i> ^[48] , 2011	RCT	133 participants	Subjects admitted to the emergency room and clinical departments and screened for attempted suicide and self-harm actions during a period from 2005-2007	133 participants randomized to Intervention group: (n = 69) received home visit and additional contact (telephone calls and text messages) Control group (n = 64) received no contact	Proportion of patients who repeated suicide attempt; number of suicidal acts	12 mo	There were a significant lower proportion who repeated a suicide attempt the intervention group and the number of repetitive acts was also significant lower Proportion of patients who repeated suicide attempt: Intervention group: 8.7%; Control group: 21.9% (Fewer events for intervention group vs control group; log rank <i>P</i> = 0.0414) Number of suicidal acts: Intervention group: 8; Control group: 22 (log rank <i>P</i> = 0.0037)

RCT: Randomized controlled trial.

significantly reduce the repetition of self-poisoning^[29-31], self-harm^[32-35] and suicide^[35]. However, although Beautrais did not find a statistically significant reduction in repetition of self-harm, she noted a reduction in the total number of new admissions to the ED for self-harm.

Regarding the two studies included in this review which examined both letters and telephone contacts, one^[36] showed no significant differences in the number of new suicide attempts in the two groups of intervention and control with the proportion of patients who reattempted suicide not differing significantly at 12 mo. The other study^[37] demonstrated a higher rate of self-harm in the experimental group compared to the control group after 12 mo of follow up.

Nine studies that used only telephone contacts as a means of prevention of suicide in the post discharge period were included in our review. Of these, four studies showed a benefit in terms of suicide risk reduction^[38,39] with a significant decrease in the number of suicide reattempts^[41] at one month follow-up and a decrease in the number of deaths by suicide at 18 mo^[42]. One study demonstrated a statistically significant decrease in the rate of patients who reattempted suicide at 1 year^[44], but not at 5 years^[45]. Three other studies, however, found no significant differences^[40,43,46] in terms of suicide risk reduction through the use of telephone contact, therefore, they cannot be considered a useful means of suicide prevention. Some authors have also assessed the simultaneous use of multiple media such as telephone calls, emails, text messages and letters^[47,48], and have

found promising results regarding the reduction in the risk of reattempting suicide. Thus, we can conclude that approximately half of the studies considered in our review (11 of 23) have shown that new technologies can be used with some benefit to decrease the risk of new attempts of suicide or self-harm in the post discharge period. It was also observed that telephone contacts, postcard, text message, *etc.*, are easily used by patients in the period of post discharge and allow a contact that is thought to be beneficial. Future researchers should continue to improve and test new technologies in the prevention of suicide. For example, an online, unguided, self-help intervention for reducing suicidal ideation was recently found to be useful, usable, and cost effective^[50]. Also Berrouguet *et al.*^[51] designed a 2-year multi-center randomized controlled trial which will assess the efficacy of a text message intervention on reducing the risk of suicide attempt repetition among adults after self-harm. This intervention is called SIAM (suicide intervention assisted by messages) and it represents an easily reproducible intervention that aims to reduce suicide risk in adults after self-harm. Also Vaiva *et al.*^[52] have developed and examined the effectiveness of "ALGOS algorithm", an intervention based on systematic telephone contacts and a crisis card, which aims to reduce the incidence of repeated suicide attempt during the 6 mo following discharge. The authors suggest that this intervention will be easily reproducible and will supply guidelines for assessment and management of this high-risk population.

LIMITATIONS

This paper does not present a systematic review or a meta-analysis. It is also possible that studies were missed or excluded. Our review focused on a range of interventions (telephone, postcards, letters, green/crisis cards, text messages, email) that may have a different effect. We examined the role of these interventions on suicide and on self-harm, acknowledging that these are two very different and distinct behaviors. Our focus was on English language literature and more important source of data may be available in other languages.

CONCLUSION

Through our review of the literature concerning the new technologies and the prevention of suicide, we have concluded that it is necessary to reach out and initiate contact with the patient who has attempted suicide following hospital discharge. Moreover, we observed that new technologies and brief contact interventions (e.g., letters, green cards, telephone calls, postcards) are valuable in the prevention of suicide and should be employed in conjunction with standard treatments. Patients who are utilizing these methods consider them usable, effective, efficient, and secure. We have determined that new technologies have the potential to be important suicide prevention resources; however, it is necessary to further examine the possible benefits of these efforts through well-designed clinical trials.

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Catatonia as a putative nosological entity: A historical sketch

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Abstract

Kahlbaum was the first to propose catatonia as a separate disease following the example of general paresis of the insane, which served as a model for establishing a nosological entity. However, Kahlbaum was uncertain about the nosological position of catatonia and considered it a syndrome, or "a temporary stage or a part of a complex picture of various disease forms". Until recently, the issue of catatonia as a separate diagnostic category was not entertained, mainly due to a misinterpretation of Kraepelin's influential views on catatonia as a subtype of schizophrenia. Kraepelin concluded that patients presenting with persistent catatonic symptoms, which he called "genuine catatonic morbid symptoms", particularly including negativism, bizarre mannerisms, and stereotypes, had a poor prognosis similar to those of paranoid and hebephrenic presentations. Accordingly, catatonia was classified as a subtype of dementia praecox/schizophrenia. Despite Kraepelin's influence on psychiatric nosology throughout the 20th century, there have only been isolated attempts to describe and classify catatonia outside of the Kraepelinian system. For example, the Wernicke-Kleist-Leonhard school attempted to comprehensively elucidate the complexities of psychomotor disturbances associated with major psychoses. However, the Leonhardian categories have never been subjected to the scrutiny of modern investigations. The first three editions of the DSM included the narrow and simplified version of Kraepelin's catatonia concept. Recent developments in catatonia research are reflected in DSM-5, which includes three diagnostic categories: Catatonic Disorder due to Another Medical Condition, Catatonia Associated with another Mental Disorder (Catatonia Specifier), and Unspecified Catatonia. Additionally, the traditional category of catatonic schizophrenia has been deleted. The Unspecified Catatonia

category could encourage research exploring catatonia as an independent diagnostic entity.

Key words: Catatonia; Psychomotor disturbances; DSM-5; Nosology; History

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Core tip: Kahlbaum was the first to propose catatonia as a separate disease, whereas Kraepelin concluded that persistent catatonic symptoms (particularly negativism, bizarre mannerisms, and stereotypes) were hallmarks of the catatonic subtype of dementia praecox/schizophrenia. Although the Wernicke-Kleist-Leonhard school attempted to comprehensively elucidate the phenomenology and genetics of psychomotor disturbances associated with major psychoses, the complexity of the Leonhardian catatonia concept has hindered its acceptance in mainstream psychiatry. Kraepelin's influence on psychiatric classifications led to the appearance of catatonia only as a subtype of schizophrenia in the first three editions of the DSM. Progress in this field is illustrated by the inclusion of three forms of catatonia in DSM-5, thus paving the way toward an exploration of Kahlbaum's original concept of catatonia as a distinct disease entity.

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INTRODUCTION

Catatonia, which is generally conceptualized as a syndrome and characterized by a variety of autonomic, behavioral, and psychomotor abnormalities, occurs at high frequencies of 2.7%-17% among psychiatric inpatients^[1]. The existence of different diagnostic criteria for catatonia may explain the diverse range of reported prevalence rates. For example, the simultaneous application of the Bush-Francis Catatonia Rating Scale (BFCRS)^[2] and the DSM-IV and DSM-5 criteria to the same 130 acutely ill inpatients yielded catatonia diagnosis rates of 63%, 25% and 17%, respectively^[3]. This paper outlines the historical development of the concept of catatonia as a distinct disease entity.

FIRST DESCRIPTION OF CATATONIA

Most classical authors, including Guislain, Pinel, Kiesel, Griesinger, and Arndt, described clinical pictures such as "Katalepsie und Psychose", "Melancholia attonita" and "Melancholie avec stupeur"^[4]. These descriptions partly overlap with Kahlbaum's view of catatonia as a condition characterized by unusual motor behavior, affective changes, impaired volition and vegetative

abnormalities^[5,6]. Kahlbaum was the first to propose that catatonia is a separate disease following the example of general paresis among the insane, which served as a model for establishing a nosological entity^[5]. The oft-cited definition of catatonia clearly refers to a distinct disease: "Catatonia is a brain disease with cyclic, alternating course, in which the mental symptoms are, consecutively, melancholy, mania, stupor, confusion and eventually dementia. One or more of these symptoms may be absent from the complete series of psychic symptom complexes. In addition to the mental symptoms, locomotor neural processes with the general character of convulsions occur as typical symptoms"^[5]. Later in the book, however, Kahlbaum was uncertain about catatonia's nosological position and also considered it "a temporary stage or a part of a complex picture of various disease forms"^[5], that is, a syndrome. Kahlbaum's attempt to describe catatonia as a distinct disease entity received mostly critical comments in the international literature, which failed to question his pioneering efforts to coalesce seemingly disparate psychopathological phenomena into a single clinical concept^[7-16].

A factor analysis of 26 cases reported by Kahlbaum in his 1874 book yielded both "neurological" and "psychotic depression" factors: 11 cases exhibited neurological signs, 9 exhibited epileptic seizures, 2 cases each involved tuberculosis and general paresis, and 1 case was affected by delirium due to peritonitis^[17]. This re-analysis led to the conclusion that "There is a difference between what Kahlbaum actually described and what he thought he was describing at the time"^[17].

In the decades following the publication of Kahlbaum's groundbreaking book, catatonic symptoms were described for a host of psychiatric disorders and medical disorders, including mania^[11,13,15,18], depression^[13,14], infectious diseases, toxic states, delirium, mental retardation and syphilis^[8,11]. By the time that seminal papers on catatonia by Seglas and Chaslin^[8], Urstein^[11], Kirby^[15] and Schneider^[19] appeared, the concept of catatonia as a separate disease had largely been discarded and, with the exception of a few authors^[7], the ubiquitous nature of catatonic signs/symptoms and of the catatonic syndrome itself had been generally accepted in classical continental psychopathology, *i.e.*, mainly German and French psychiatry during the second part of the 19th century and the first few decades of the 20th century.

The concept of catatonia as a syndrome in Anglo-Saxon (English and American) psychiatry was revived and confirmed by Gelenberg^[20] some 60 years later. Until recently^[1,2,6], the issue of catatonia as a separate diagnostic category was not entertained, mainly owing to the misinterpretation of Kraepelin's influential views.

Catatonia as part of dementia praecox (schizophrenia)

In addition to the symptoms, illness course, and autopsy findings, the final outcome was a principle used

by Kahlbaum^[5] to construct his nosology. The outcomes of Kahlbaum's 26 catatonia cases were inconclusive: 8 experienced remission and 8 died or became chronic ("demented"), whereas no follow-up information was available for 10 cases^[5].

Kraepelin^[21] followed Kahlbaum's nosological principles. However, only one of his 63 catatonic patients, who were followed up for an average of 4 years, completely recovered. An additional 39 never remitted, and even those who remitted showed residual symptoms. In his 1908 textbook, Kraepelin estimated that 13% of catatonia patients would remit^[22]. A study of 200 catatonic patients observed between 1901 and 1905 reported a remission rate of 19%^[23]. Based on these data and his own clinical experience, Kraepelin concluded that patients presenting with persistent catatonic symptoms he called "genuine catatonic morbid symptoms", particularly negativism, bizarre mannerisms and stereotypes, had a similarly poor prognosis as did those with paranoid and hebephrenic presentations. Thus, catatonia became a subtype of dementia praecox/schizophrenia^[22]. While acknowledging the catatonic symptoms associated with mood-related and other psychiatric illnesses, Kraepelin emphasized that the above symptoms were "more characteristic (and) scarcely accompanying any other morbid process in a pronounced form throughout a long period"^[22]. Kraepelin also emphasized that catatonic symptoms were not diagnostic criteria for dementia praecox and that the inclusion of the catatonia subtype in his classification was temporary: "So far as judgment on the subject is possible today, we may regard the catatonia of Kahlbaum as in the main a form, though peculiar, of dementia praecox. On the other hand, catatonic morbid phenomena are undoubtedly also observed in many quite different morbid processes to a greater or lesser extent, so that its appearance alone does not justify the conclusion that catatonia in the sense just indicated (*i.e.*, as a dementia praecox subtype) is present"^[22].

In conclusion, Kraepelin devised a rather nuanced clinical concept of catatonia, as briefly outlined above. This concept was glossed over for decades, which ascribed to him the simplified view that catatonia equals schizophrenia^[6].

DISTINCT CATATONIA SUBTYPES AS PUTATIVE NOSOLOGICAL ENTITIES

Despite Kraepelin's decisive influence on psychiatric nosology throughout the 20th century, only isolated attempts have been made to describe and classify catatonia outside of the Kraepelinian system.

Lethal (malignant) catatonia

In 1934, Stauder based a description of "lethal catatonia" on 27 cases, with the intent to delineate a separate clinical entity^[24]. Stauder noted that sudden

death in a catatonic state with or without autopsy findings had been well recorded in the psychiatric literature under different names such as acute delirium, Bell's mania, delirious mania, or amentia. Currently, the preferred term is malignant catatonia^[25]. Stauder's lethal catatonia was characterized by a sudden, acute onset occurring mostly in young adults presenting with severe excitement ending in stupor, confusion alternating with mutism, rigidity and other catatonic signs and symptoms, vegetative disturbances, fever, dehydration, cardiovascular collapse and negative findings at autopsy^[25]. Although the outcome in most of Stauder's cases was fatal, mortality has become relatively rare, with a rate of 9% among the 77 cases published since 1986^[25,26]. The consensus view is that malignant catatonia is not a separate entity but a severe form of catatonic syndrome^[25,26]. Advances in neurosciences and clinical neurology have led to the determination of the etiologic agents in cases of malignant catatonia, such as paraneoplastic encephalitis^[27] or anti-NMDA encephalitis^[28].

Most but not all^[29] modern authors regard neuroleptic malignant syndrome (NMS) as an antipsychotic drug-induced variant of spontaneously occurring malignant catatonia^[30]. While the two syndromes share several clinical characteristics and possibly an underlying pathophysiology, notable differences include the lack of a prolonged excitement phase in NMS and the dynamics how the symptoms develop; typically, a few days of extreme excitement ushers in malignant catatonia followed by exhaustion and stupor^[25].

Wernicke-Kleist-Leonhard school of psychiatry

The Wernicke-Kleist-Leonhard school of psychiatry has made a comprehensive attempt to elucidate the complexities of psychomotor disturbances associated with major psychoses^[31,32]. Following Wernicke and Kleist's path-breaking work, Leonard devised the final classification of psychomotor disturbances^[31,32]. While a variety of motor signs and symptoms may appear in several neurological and psychiatric conditions, catatonic symptoms aggregate into persistent, stable syndromes associated with specific cognitive, affective, and psychotic patterns that sharply delineated categories within the schizophrenic and cycloid psychoses. Leonard's system differentiates two major groups of psychomotor syndromes: Cycloid motility psychosis and the systematic and non-systematic catatonic schizophrenias. Motility psychosis, described originally by Wernicke, presents with akinetic and hyperkinetic poles both characterized by episodic course, good prognosis and motor symptoms which, although excessive, differ only quantitatively from normal movements, *i.e.*, lack odd/bizarre qualities). Most modern authors would undoubtedly regard motility psychosis as catatonia^[33].

The six subtypes of systematic catatonias and non-systematic periodic catatonia are distinguished from normal psychomotor patterns by their qualitative and quantitative differences. Unlike motility psychosis,

these catatonia subtypes have a poor prognosis. Once they emerge, systematic catatonias never remit, and the initially episodic course of periodic catatonia may also become chronic. The sophisticated descriptions of catatonic and akinetic-hyperkinetic syndromes cover 57 psychomotor signs and symptoms^[31,32]. A number of cross-sectional and large-scale, long-term (15-20 years) follow-up studies conducted by Kleist, Leonhard and their co-workers confirmed the reliability and stability of Leonhard's classification^[31,32,34-37].

Due to its complexity and dissimilarity to mainstream classifications, Leonhard's nosological system has never been subjected to the scrutiny of investigations using modern methods to validate these putative disease entities beyond the works of dedicated proponents of the Wernicke-Kleist-Leonhard school.

Although Leonhard's catatonia subtypes have been subsumed under the group of schizophrenias, they form distinct entities and have been sharply delineated from the rest of schizophrenia subtypes, thereby constitute relatively independent, albeit putative catatonic disease entities.

Periodic catatonia

Periodic catatonia is not recognized by the ICD-10 or any version of the DSM. This nosological category is not well established, and there is no consensus regarding the relevant diagnostic criteria except for the Wernicke-Kleist-Leonhard classification, which has hardly been acknowledged by mainstream psychiatry. Discussions regarding periodic catatonia have always raised two continuously unresolved nosological issues: Whether it is a separate disease entity or just a variant of catatonia with an episodic course and whether it is a clinical form of bipolar affective disorder^[22,26].

Catatonia with episodic presentation was recognized as early as 1894, when Nacke coined the term "Katatonie alternans"^[38]. Bleuler^[38] described similar cases and stated that "we recognize catatonias which run a periodic course". Kraepelin^[22] presented several vignettes on periodic catatonia while discussing periodic, agitated, and circular dementias, and the catatonic forms of dementia praecox, but concluded rather dismissively that "some of the smaller groups will in course of time be got rid of [...] namely for the cases [...] with a periodic course"^[22]. However, he did not proceed with an argument regarding why these cases should not be included among the catatonias^[22].

Despite its marginal place in nosology, in clinical practice periodic catatonia attracted the first rigorous investigations in biological psychiatry that spanned more than four decades. The father and son duo Rolv and Leiv Gjessing devoted a lifetime of research to periodic catatonia, a special form of schizophrenia. The subjects of their investigations were patients in whom catatonic stupor and excitement occurred with rhythmic periodicity over long periods and were regarded as two facets of the same pathophysiological process. The

catatonic condition was painstakingly recorded and correlated with biochemical variables. Cyclic alternations in the nitrogen balance were observed to follow changes in the clinical presentation simultaneously with the catecholamine metabolism, autonomous nervous system, and EEG findings^[39,40]. These findings have not been confirmed or refuted by other investigators using modern methods of neurobiology. The treatment of periodic catatonia with large doses of thyroid hormone to correct the nitrogen imbalance was made obsolete by the introduction of antipsychotics and lithium, which proved to be effective^[41].

The Wernicke-Kleist-Leonhard school paid much attention to the clinical and genetic aspects of periodic catatonia, one of the three non-systemic schizophrenic psychoses characterized by polymorphous clinical presentation and a cyclic/bipolar course, which not infrequently becomes chronic^[31]. In addition to psychotic symptoms, the specific catatonic features include the tendency of the two poles (stupor and excitation) to alternate, or appear simultaneously with signs/symptoms of impulse/aggression preparedness, affective tension, parakinesis, stiff/choppy movements, grimaces (particularly in the upper part of the face), iterative motor stereotypes, and negativism. Extensive clinical genetic studies conducted by Leonhard and his pupils confirmed the high familial incidence of homotypical psychoses in periodic catatonia, yielding a cumulative morbidity risk of 26.9% among first-degree relatives^[32,42]. Subsequent and ongoing genome-wide linkage investigations identified two susceptibility loci on chromosomes 15q15 and 22q13^[43]. These findings await replication by independent investigators.

Idiopathic catatonia

Ever since Kahlbaum conceptualized catatonia as a putative disease entity, there have been proponents of this idea although it has never gained currency in mainstream psychiatry. Recent reports suggest that in a significant minority of cases a catatonic syndrome appears without any underlying diagnosable psychiatric disorder or medical condition^[33,44-49]. Case reports of presumably idiopathic catatonia describing clinical presentations that did not meet modern diagnostic criteria for any psychiatric illness^[33,47-49] correspond to the traditional Leonhardian categories of periodic catatonia or motility psychosis^[33]. Two studies from India compared idiopathic catatonia with catatonic schizophrenia ($n = 13$ vs $n = 21$)^[45] and depression with catatonic schizophrenia ($n = 30$ vs $n = 35$)^[46]. Idiopathic cases differed from the controls by shorter duration of illness, a preponderance of female patients^[45], reduced overall psychopathology as measured by the Brief Psychiatric Rating Scale (BPRS), and higher scores regarding specific catatonia features, particularly negativism, waxy flexibility, Mitgehen, and ambitendency^[46]. Further studies are warranted to replicate and extend these preliminary findings. The new DSM-5 diagnosis of Unspecified Catatonia will be the

appropriate category for idiopathic catatonia in psychiatric classification.

CATATONIA IN SUCCESSIVE EDITIONS OF DSM

In the first three editions of DSM catatonia appeared only as a subtype of schizophrenia following a narrow and simplified version of Kraepelin's catatonia concept.

A landmark paper by Gelenberg^[20] heralded the rediscovery of catatonia as a syndrome based on knowledge known since Kahlbaum's time that catatonic signs/symptoms are found in several medical and neurological conditions. Reflecting this paradigm shift in modern psychiatry, the new category of Catatonic Disorder Due to a General Medical Condition was introduced in DSM-IV while still retaining the category of Schizophrenia, Catatonic Type^[50]. As catatonic syndromes were observed with increasing frequency in patients with mood disorders^[51], Catatonic Features was added as a specifier to describe mood disorders more accurately. Catatonic features could be diagnosed if 2 of the 5 composite signs/symptoms were present. Over the past 20 years, the number of publications on catatonia has grown significantly^[52]. Rating scales^[53] have been constructed and clinical^[54], treatment^[55], and biological studies^[56] have appeared. Books^[26] and review papers^[57-59] have helped make clinicians cognizant of the clinical significance of catatonia. The development in the field is mirrored in DSM-5^[60], which includes three forms of catatonia: Catatonic Disorder Due to Another Medical Condition, Catatonia Associated with Another Mental Disorder (Catatonia Specifier) and Unspecified Catatonia. The traditional category of catatonic schizophrenia was deleted. The diagnostic criteria for the first two categories are identical and require the presence of 3 out of 12 common catatonic signs/symptoms, including stupor, catalepsy, waxy flexibility, mutism, negativism, posturing, mannerism, stereotypy, agitation, grimacing, echolalia and echopraxia.

Unspecified Catatonia, an independent category in DSM-5, is an entirely new, potentially important development in the recognition of catatonia as a distinct diagnostic entity^[61]. However, this category remains ambiguous toward catatonia as a separate diagnosis because it was intended to be applied to conditions where "either the nature of the underlying mental disorder or other medical condition is unclear, full criteria for catatonia are not met, or there is insufficient information to make a more specific diagnosis". Uncertainty about the nosological position of catatonia is demonstrated by the placement of the three catatonia diagnoses in the Schizophrenia and other Psychotic Disorders section. Nevertheless, the catatonia concept espoused by DSM-5 constitutes a major step forward and will stimulate the exploration of a separate catatonia diagnosis in clinical practice. Additionally, this concept will foster research^[1], particularly if the soon-to-

be published ICD-11 follows a similar path.

CONCLUSION

The validity and clinical utility of catatonic schizophrenia in the traditional Kraepelin-Bleuler classificatory system is limited. In an attempt to replace the Kraepelin-Bleuler model, the dimensional approach reaches beyond the classical concept of catatonic schizophrenia. Complex neurobiological and clinical investigations, including the quantification of individual or clusters of catatonic signs and symptoms, have recently taken shape within broadly defined groups of mood disorders and psychoses^[62-64]. This dimensional approach reduces bias attributed to the narrow and uncertain nosological categories.

The catatonia concept espoused by DSM-5 constitutes a promising step forward by stimulating the exploration of a separate catatonia diagnosis in clinical practice. It could also foster research^[1], such as whole-genome association, epigenetic, and metabolomics studies, particularly if the soon-to-be published ICD-11 is similar to DSM-5.

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Transition to school for children with autism spectrum disorder: A systematic review

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Abstract

AIM

To identify factors that promote a positive start to school for children with autism spectrum disorder (ASD).

METHODS

Web of Science, MEDLINE, Scopus, and PsychINFO searches were conducted to identify literature published after 1991 and relevant to school transition processes in children with ASD. Twenty studies were deemed eligible for inclusion. These studies evaluated a range of factors including school readiness, parent and teacher perspectives on transition practices, characteristics of children with ASD that are associated with successful transition to school and the impact of school based intervention programs.

RESULTS

A review of these studies showed that children with ASD are less school ready emotionally than their peers and those children with ASD appear to have more externalising behaviours and self-regulation difficulties that affect their school engagement and their relationships with their teachers. There was a paucity of research looking at interventions targeting school readiness. However, school-based behavioural interventions appear to improve cognitive, language and daily living skills, but have less impact on socialisation and peer inclusion.

CONCLUSION

Children with ASD face more challenges transitioning

to school, particularly with social interaction. Further development and implementation of specific school-based interventions is needed in order to assist children with autism to maximise their success in starting school.

Key words: Autism spectrum disorder; School transition; School readiness; School preparation; School based intervention

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Core tip: This systematic review examines current school transition research for children with autism spectrum disorder (ASD), focusing on school readiness, parents and teachers school transitions expectations and experiences, individual factors affecting school transition and school-based interventions. Research in this area is disparate and sparse, but suggests that children with ASD have more difficulty adjusting to school, particularly in relation to active engagement and social interactions with the teachers and peers. Teachers and parents agree comprehensive transition processes are needed throughout the first years. School-based intervention programs in the first years can improve cognitive, language and daily-living but more interventions are needed targeting social interaction.

Marsh A, Spagnol V, Grove R, Eapen V. Transition to school for children with autism spectrum disorder: A systematic review. *World J Psychiatr* 2017; 7(3): 184-196 Available from: URL: <http://www.wjgnet.com/2220-3206/full/v7/i3/184.htm> DOI: <http://dx.doi.org/10.5498/wjpv.7.i3.184>

INTRODUCTION

Starting school is a major event in any child's life and while for children with disabilities this transition can be challenging^[1], this is particularly significant for children with autism spectrum disorder (ASD). The unique social, communication and behavioural difficulties that children with ASD experience may present additional barriers to a positive start to school^[2,3]. This is particularly relevant as teachers rate social skills as more important than academic skills for successful kindergarten adjustment^[4]. An increasing body of evidence supports the notion that children who have a positive start to school are likely to engage well and experience academic and social success^[2,3]. Children with ASD have a greater risk of poor school outcomes including emotional and behavioural problems^[5] and bullying^[6] that result in school exclusion^[7] or peer rejection^[8]. It is therefore critical that protective factors, as well as barriers to positive school transition in children with ASD are identified and understood^[2,3].

The transition process begins at pre-school age whereby the child is prepared for school while also

evaluating if the child is "ready", described as "school readiness". Typically, the focus has been on the child "gaining competence" in a range of areas; emotional, behavioural, social and academic^[9]. However, it is equally important that parents, schools and teachers are prepared for the special needs of children with ASD. Consequently, it is important to identify the strengths and deficits of children with ASD before they start school, as well as obtaining multiple perspectives from all parties. For this transition process to be successful, intervention and support needs to go beyond the preparation stage and continue after the commencement of school. Decades of research has demonstrated the positive effects of early intervention programs for children with ASD and also the success of later intervention programs for school-aged children. However, substantially less research has specifically evaluated school-based interventions^[10,11]. Additionally, much of this research has focused on the later years and not the critical "transition to school" period in the first years of primary school^[11]. Finally, for children with ASD, interventions targeting socialisation and communication skills are critical. In order to provide a successful start to school for these children, it is therefore important to develop school-based programs that target a range of skill development across behavioural and social as well as academic domains. However, to develop evidence-based programs, it is important to first establish what aspects of current school-based interventions have been successful in targeting a wide range of skills and behaviours.

While there has been considerable research undertaken on typically developing children's transition to primary school, there is a paucity of empirical studies that examine transition to school for children with ASD^[4,12]. Additionally, the research available is not disseminated and there is a lack of synthesis of the available evidence that means that strengths and weaknesses in our current knowledge base are not readily apparent. Thus, there is a great need to establish and consolidate the current evidence on how and when children with ASD are ready for school, the types of supports required by children with ASD, their families and schools, and specific interventions and individual factors that serve to enable a positive start to school. This paper will review the existing research on the preparation and transition of children with ASD to primary school. Specifically, this systematic review aims to examine: (1) School readiness of children with ASD; (2) Parents' and teachers' views and experiences of the school transition process for children with ASD; (3) The characteristics related to positive school transition experiences for children with ASD, such as individual characteristics of the child as well as family variables and teacher, classroom and school characteristics; and (4) School-based interventions to enhance school readiness and transition in the first years of school that were associated with successful school transition for

children with ASD.

MATERIALS AND METHODS

Search strategy

Studies included in this review were located by searching the following electronic databases; Web of Science, MEDLINE, Scopus, and PsychINFO from January 1991 and April 2016. The search was limited to articles published after January 1994, given the adoption of the Individuals with Disabilities Education Act in the early 1990s by the federal government in the United States of America with autism included as a special education category^[13], as well as the DSM expanding the definition of autism to include Asperger syndrome. The search was also limited to English language articles only. Secondary searches outside the official databases listed above were undertaken of relevant government and not for profit organisation websites, and ancestral searches were undertaken of the reference lists and reverse citations of included studies.

Searches were undertaken using a combination of the following descriptors: Autism, ASD, pervasive developmental disorder, pdd-nos, ASD, Asperger's syndrome, school transition, school readiness, school preparation, school adjustment, school engagement school entry, school based intervention, elementary school, primary school, kindergarten, preschool, educational interventions, early education, learning/mathematics/reading/literacy ready, learning/mathematics/reading/literacy achievement, learning/mathematics/reading/literacy acquisition and learning/mathematics/reading/literacy development. This broad range of keywords was used in an attempt to capture all articles relevant to the school transition process for children with autism.

Inclusion and exclusion criteria

Inclusion eligibility was based on the following seven criteria. First, only studies that specifically examined children with autism were included. Second, the age for starting school varies from country to country but generally is between 3 and 8 years. Any articles outside of this age range were excluded. Articles with children over 8 years were included if it was a longitudinal study with a baseline within the appropriate age range or if the study was cross-sectional with a younger age group identified and examined as a separate condition within the appropriate age range. Third, survey and interview studies must have targeted parent and teacher views of school transition experiences or school readiness experiences. Fourth, studies assessing and/or monitoring functioning and adjustment in the first year of school were included. Fifth, school based intervention studies in the first year were included if they targeted school readiness or school transition. Intervention studies did not need to discuss school transition specifically but had

to be school based with outcome measures that targeted school transition factors (e.g., general academic progress and/or social development). Intervention studies in first years of school only targeting very narrow and specific outcome measures (e.g., word learning) were excluded. Intervention studies prior to school commencement must have used specific school readiness outcome measures and school readiness needed to be assessed at critical time point. Sixth, single-subject studies with small sample sizes (< 5) were excluded. Finally, PhD dissertation studies that had not been subsequently published as a peer reviewed journal article were included (dissertations that had been rewritten as a published manuscript were excluded).

Data extraction and synthesis

The titles and abstracts of the initial search were screened to identify potentially relevant articles. The first and second authors independently assessed the full-text of these publications for eligibility and any disagreements about inclusion were resolved through discussion and consensus. Study characteristics, number of participants, participant data including diagnosis, age range, intervention, and outcome measures were extracted and recorded on a data extraction form.

RESULTS

Studies identified and included

The initial search identified 1575 publications (excluding duplicates). After screening, 137 were identified for full-text review and of these, 20 met the selection criteria and were included in this review (Figure 1). These articles were grouped according to four criteria: School readiness ($n = 4$); parents' and teachers' school transition expectations and experiences ($n = 4$); individual factors affecting school transition ($n = 5$); and school based interventions ($n = 7$). An overview of the included articles is presented in Table 1.

School readiness

Three studies examined school readiness in children with ASD. However, there was substantial heterogeneity in the study designs and outcome measures. Nonetheless, these studies appear to indicate that while children with ASD show basic academic school readiness, they do not appear to be ready in the areas of social skills and daily living skills. A study by Crane^[14] demonstrated that children with ASD enrolled in special education in pre-school through second grade had significantly poorer self-help skills, self-control and relationships than children with learning disabilities, speech/language impairments, emotional difficulties, and health problems. Moreover, a recent study by Klubnik *et al.*^[15] examined understanding of school-based concepts and self-/social awareness concepts in children with ASD and Intellectual Disability (ASD/ID) and ID. Results revealed that when controlling

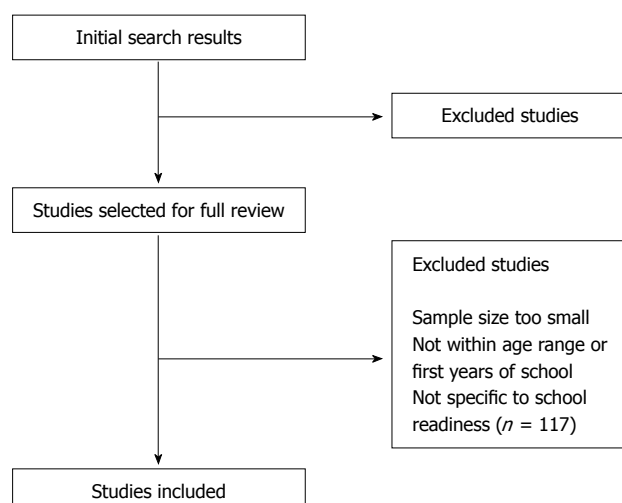


Figure 1 Search flow chart.

for age, IQ and communication skills, children with ASD/ID had significantly poorer understanding of self-/social awareness concepts than children with ID. Additionally, within the ASD/ID group, understanding of academic concepts (*e.g.*, numbers, letters) exceeded understanding of self-/social awareness concepts by more than one standard deviation, suggesting that although children with ASD may have a relative strength in academic readiness, they appear to be significantly behind their non-ASD peers in terms of social readiness.

Matthews^[16] examined the link between early childcare experiences, friendship quality, Theory of Mind (ToM), and school readiness in children with ASD and their typically developing peers, and found poorer positive friendship quality, ToM, and school readiness in children with ASD. For all children, more positive friendship quality was associated with higher social-emotional school readiness and self-help school readiness, and was positively related to ToM in children with ASD, but negatively related ToM in controls. Child care experiences were not associated with ToM in either group. In fact, more time spent in child care was associated with poorer school readiness for children with ASD. Finally, ToM was also positively related to cognitive/motor school readiness, mediated by receptive language ability, for children with ASD.

Waddington and Reed^[17] was the only study found that looked specifically at an intervention that prepared children with ASD for school. This study examined the Preschool Inventory of Repertoires for Kindergarten (PIRK; Greer and McKorkle, 2003 as cited in^[17]) to determine its effectiveness in transitioning children to primary school. Specifically, they investigated whether using the PIRK teaching program had an impact on skills and behaviour and enabled children to transfer from special to mainstream schools. Children's progress in the PIRK program, a program based on Applied Behaviour Analysis (ABA) targeting individual children's specific curriculum deficits, was compared with the

progress of children with ASD in an education as usual group, which had eclectic intervention approaches. Children in the PIRK program displayed improved communication and daily living skills. Importantly these improvements facilitated the transition process and continued in mainstream schools for these children. However, the children's social skills did not appear to improve as a result of the PIRK program^[17].

Overall, these studies indicate that children with ASD are less school ready in social-emotional areas than both typically developing and developmental delayed peers. In addition, there is a preliminary suggestion that interventions targeting school readiness can improve communication and self-help skills. However, further intervention targeting social skills may be required.

Parents and teachers school transition expectations and experiences

In total, four autism-specific studies investigating teachers' and parents' perspectives of children with ASD on particular transition practices were identified in the literature. The elements for successful transition to school were fairly consistent across these studies^[1,2,4,18]. These centred around the following themes: "Child visit, parent information, teacher sharing, placement identification, decision support, sending teacher, support identification, evaluation administrator, visit support, and peer preparation"^[18] (p. 135). These studies also consistently showed that parents, carers, preschool and primary school teachers strongly endorse all of these practices for transitioning children with ASD into primary school^[1-3,18]. Unfortunately, while all the relevant stakeholders consider these practices important, teachers report that few of these practices are actually implemented in real-life settings^[1,3,4]. Quintero and McIntyre^[1] surveyed 96 parents and teachers of children with disabilities, 19 of whom had ASD. They found that teachers had substantially more concerns about children with ASD regarding transition to kindergarten than they had for children with other disabilities. While parents and teachers, particularly preschool teachers, were highly involved in the transition process for all children with a disability, transition practices were generic and rarely individualised to each child's particular needs^[1]. Parents reported kindergarten teachers engaged in some settling practices at the beginning of the school year but did not implement transition practices with on-going transition programs nor regular meetings^[1].

One particular transition process highlighted in the literature, as being particularly important, is regular and detailed communication between the relevant stakeholders. Quintero and McIntyre^[1] reported that this process rarely occurs between preschool staff and kindergarten teachers. Preschool teachers reported concerns about the lack of collaboration with kindergarten staff for children with disabilities leading up to school entry and during the transition process. Equally important is parent-teacher communication. There also appears to

Table 1 Summary of studies examining school transition for children with autism spectrum disorder

Author (yr)	Country	Sample	Intervention	Measures	Findings
School readiness Crane ^[14] (2010)	United States	91 children with ASD; 1338 children with ASD and other disabilities	Children received special education services	(DECA; LeBuffe and Naglieri, 1999); (LAP-D; Nehring, Nehring, Bruni and Randolph, 1992), Early Learning Accomplishment Profile (ELAP; Glover, Preminger and Sanford, 2002), (SRUSS), ESI-K, DIBELS, SAT-10	Children with ASD (and developmental delay group) showed the slowest gains over time in the language, cognitive and fine motor domains. Children with ASD had significantly lower scores on the initiative, self-control and attachment scales than all groups except the developmental delay group
Klubnik, Murphy, Campbell, Reed and Warner-Metzger ^[15] (2014)	United States	Exp group: 76 children with ID and ASD, M = 53.60 mo. Comp Group: 47 children with ID, M = 59.25 mo		Stanford-Binet Intelligence Scales, Fifth Edition (SB5; Roid, 2003), Childhood Autism Rating Scale, Second Edition (CARS-2; Schopler, Van Bourgondien, Wellman, and Love, 2010), Vineland Adaptive Behaviour Scale, Bracken Basic Concept Scale- Third Edition: Receptive (Bracken, 2006)	Receptive understanding of self-/social awareness concepts was significantly lower for the ASD/ID group. ASD/ID group had significantly higher school readiness scores than the ID group. The ASD/ID group's the School Readiness Composite was greater than their Self/Social-Awareness subtest
Matthews ^[16] (2014)	United States	Exp: 63 children with a parent-reported diagnosis of ASD, M = 5.16 yr (4-6 yr). Comp Group: 33 TD children, M = 5.35 yr (4-6 yr)		Background information; History of child care; Friendship quality; School readiness - parent report of social-emotional and self-help school readiness; Theory of Mind (ToM) Developmental Scale (Wellman <i>et al</i> , 20016; Wellman and Liu, 2004); Appearance-reality (Wellman and Liu, 2004); Second-order false belief (Tager-Flusberg and Sullivan, 1994); School readiness - Cognitive/motor (Cognitive: Concept tasks; Cognitive: Language tasks; Motor tasks); Verbal ability [Peabody Picture Vocabulary Test-III (Dunn and Dunn, 1997)]	Children with ASD, experiencing centre-based care was not associated with cognitive/motor school readiness, social-emotional school readiness, or level of self-help school readiness. Children with ASD who demonstrated more advanced ToM performance had higher cognitive/motor school readiness and levels of self-help school readiness. Both groups, children with more positive friendship quality had higher levels of social-emotional school readiness and self-help school readiness
Waddington and Reed ^[17] (2009) (Study 2)	United Kingdom	Exp group (PIRKS): 12 children with ASD, Baseline, M = 6.7 yr (4.3-10.5 yr), Comp Group (Treatment as usual (TAU)): 15 children with ASD, Baseline, M = 9.1 yr (5.2-15.0 yr)	PIRKS prepare children for inclusion in a mainstream kindergarten; based on ABA; 5 skill areas: Academic literacy, communication, listening, speaking, social self-management, school self-sufficiency, community, physical/motor. Individualised. Teaching takes place 1:1 or small groups	Gilliam Autism Rating Scale (GARS; Gilliam, 1995), Vineland Adaptive Behavior Scale, Mainstreaming Social Skills Questionnaire (MSSQ; Salend and Lutz, 1984), Strengths and Difficulties Questionnaire (SDQ; Goodman, 1987)	Children who had experienced PIRKS prior to attending mainstream schools demonstrated improvements in communication, socialisation, and daily living skills (not compared with comparison group just significant improvements within group) with these skills continuing at mainstream school
Parents'/teachers' views/experiences of school transition process Beamish, Bryer and Klieve ^[18] (2014)	Australia	91 intervention and advisory (specialised preschool) teachers		Transition practices online survey: 36 practices items identified from review of literature (including Forest <i>et al</i> , 2004). Themes: Child visit, Parent information, Teacher sharing, Placement identification, Decision support, Sending teacher, Support identification, Evaluation administrator, Visit support, Peer preparation	All 36 practices highly endorsed
Denkyirah and MAgbeke ^[2] (2010)	United States	Exp group: 306 preschool teachers. Comp group: 82 preschool		Survey developed from Forest <i>et al</i> , 2004. Themes: Timing for planning and preparation; Sharing information with family; Discussing placement with family; Helping families fin school	All themes endorsed by teachers in both countries

		teachers from Ghana	and community resources; Preparing and receiving school and teachers; Relationships between sending and receiving schools; Assistive technology; Home visit; Parent taring	
Fontil and Petrakos ^[4] (2015)	United States	Parents of 10 children (aged 53.8-87.4 mo) with or suspected of having ASD	Interview questions adapted from Kindergarten Transition Parent Interview - Preschool (Pianta and Kraft-Sayre, 2003). Themes: child's experiences at school, their peer contact, their activities at home, and parents' personal activities with the school. Measure of Processes of Care (MPOC-20; King, King and Rosenbaum, 2004) Time 1 - end of preschool; Parents: Family Experiences and Involvement in Transition (FEIT; McIntyre <i>et al.</i> , 2007); Preschool teachers: Teachers' Perceptions on Transition (TPOT), Open Ended Questions in TPOT. Time 2 - kindergarten entry; Parents: Family Experiences and Involvement in Transition (FEIT; McIntyre <i>et al.</i> , 2007)	Empathy, Caring, and Understanding: Relationships with preschool teachers more positive than with kindergarten teachers. Knowledge and Expertise: More sharing of information with parents at preschool than school. Less educational opportunities and resources at school than preschool Teachers' Perceptions on Transition: Teachers significantly more likely to report higher concerns (some, many, or very many concerns) for children with ASD than children with DD. Teachers endorsed visiting students' assigned kindergarten classroom more for children in the ASD group than the DD group. Parent Involvement: Parents of DD group reported participating in a transition planning meeting significantly more than parents in the ASD group. Parents of DD group reported to have received written communication regarding the transition from the kindergarten program significantly more than parents in the ASD group
Quintero and McIntyre ^[1] (2011)	United States	Exp group: Parents and teachers of 19 children with ASD (M = 58.84 mo). Comp group: Parents and teachers of 76 children with Developmental Difficulties, M = 58.66 mo		
Protective and risk factors in first year of school Charman <i>et al.</i> ^[19] (2004)	United Kingdom	Cohort 1: 73 children with ASD, Cohort 2: 52 children with ASD; Baseline both cohorts M = 56.6 mo	Vineland Adaptive Behavior Scales-Screen Version (VABS-S; Sparrows, 2000), Social Communication Questionnaire (SCQ; Berument <i>et al.</i> , 1999), Autism Treatment Evaluation Checklist (ATEC; Rimland and Edelson, 1999)	Group made more rapid development progress in the 11 mo in school than they had preschool. Pattern of change on the ATEC was mixed. On the social, language and communication subscale the scores did significantly reduce over time. The best developmental progress was made by children with better communication skills at the outset High externalising behaviour predicted poor STR and was not moderate by cognitive abilities.
Esienhower, Blacher and Bush ^[12] (2015)	United States	166 children with ASD (M = 5 yr 8 mo, 4-7 yr) and one parent per child	Demographics, ADOS, abbreviated WPPSI-II, Student-Teacher Relationship Scale (STRS; Pianta, 2001), Caregiver-Teacher Report Form and Teacher Report Form (CTRF and TRF; Achebach and Rescoria, 2000, 2001)	
Jahromi, Bryce and Swanson ^[20] (2013)	United States	Exp group: 20 children with HFASD, M = 58.95 mo. Comp group: 20 typically developing children, M = 50.20 mo	Measures: Preschool Language Scale 4 (PLS-4; Zimmerman, Steiner, and Pond, 2002), Differential Abilities Scale II (DAS-II; Elliot, 2007), Autism Diagnostic Interview-Revised (ADI-R; Lord <i>et al.</i> , 1994), Social Communication Questionnaire (SCQ; Rutter <i>et al.</i> , 2003), Emotion Regulation Checklist (ER Checklist; Shields and Cicchetti, 1997), Day/Night Task (Gerstadt, Hong, and Diamond, 1994), Behavior Rating Inventory of Executive Function-Preschool Version (BRIEF-P; Gioia, Isquith, Guy, and Kenworthy, 2000), Parent-child joint engagement states and child-initiated joint engagement (Bakeman and Adamson, 1984), Child Behavior Questionnaire-Short Form (CBQ-SF; Putnam and Rothbart, 2006; Rothbart, Ahadi, Hershey, and Fisher, 2001), School Liking and Avoidance Questionnaire (Ladd <i>et al.</i> , 2000), parent-report version of the Teacher Rating Scale of School Adjustment (Buhs and Ladd, 2001), Child Behavior Scale (CBS; Ladd and Profilet, 1996)	Children with HFA were rated significantly lower in emotion regulation and effortful control than their typically developing peers. Behavioural engagement: children with HFA had significantly less cooperative and independent participation. Emotional engagement: Executive function emerged as the significant predictor of emotional school engagement. For children with HFA, effortful control promoted greater prosocial behaviour with peers

Prino, Pasta, Giovanna, Gastaldi and Longobardi ^[23] (2016)	Italy	Exp group: 14 children with ASD, M = 85.75 mo; 18 children with Down Syndrome, M = 85.75 mo, teacher or teaching assistant per child ($n = 32$). Comp group: 128 TD children (classmates), M = 78.54 mo ¹		Student-Teacher Relationship Scale (STRS; Pianta, 2001)	No difference between teachers' perceptions of children with Down Syndrome and their TD classmates. Teachers' reported significantly higher conflict scores and significantly lower closeness scores for children with ASD than their TD peers
Sparapani <i>et al</i> ^[21] (2016)	United States	196 children with ASD, M = 6.36 yr		ADOS, Stanford-Binet Intelligence Scale - 5 th Ed (SB-5; Roid, 2003), Peabody Picture Vocabulary Test - 4 th Ed (PPVT-4; Dunn and Dunn, 2007), Expressive One Word Vocabulary Picture Test - 4 th Ed (EOWVPT-4; Brownell, 2000), Social Skills Rating system (SSRS; Gresham and Elliott, 1990), Teacher Report Form (TRF; Achenbach and Rescorla, 2001), 60-min classroom observations. Five themes: Emotional Regulation, Classroom Participation, Social Connectedness, Initiating Communication, and Flexibility	No difference between children in general education and special education classes. Students spent less than 50% of time in a well-regulated state, productively and independently participating in classroom activities. Students only responded to half of verbal bids for interaction, infrequently directed communication, and rarely used generative language
Grindle <i>et al</i> ^[10] (2012)	United Kingdom, 4-5 yr	Exp group (ABA): 11 children with ASD, baseline: Age range 43 to 68 mo (M = 58.2 mo). Comp group [Education as usual (EAU)]: 18 children with ASD baseline: Age range 54 to 72 mo (M = 63.89 mo)	School-based comprehensive behavioural intervention features: (1) Parents generalize skills at home; (2) One-to-one intervention at desks in a shared classroom; (3) Education for a maximum of 6 h per day for 38 wk of year; (4) Matched school timetable; (5) Generalise skills to mainstream classes; and (6) based on the United Kingdom National Curriculum	IQ: Stanford-Binet Intelligence Scale -Fourth Edition or Leiter International Performance Scale-Revised; Vineland Adaptive Behavior Scale-Survey Form (VABS); ABLLS/ ABLLS-R assesses skills such as effective social and communicative functioning, imitation, and cooperation	Positive changes were observed for the majority of children enrolled in the ABA class - moderate to large-sized effects found for standardized test outcomes after 1 yr of intervention. Outcomes for ABA class were positive compared with the treatment as usual
Kamps <i>et al</i> ^[11] (2015)	United States	Exp group (Peer Networks Intervention): 56 children with ASD, baseline: Age M = 5.8 yr. Comp group (EAU): 39 children with ASD baseline: Age M = 5.8 yr	Peer network intervention: peer training and direct instruction. Five skills: (1) Requests and shares; (2) Comments about one's own play; (3) Comments about others' play; (4) Niceties, <i>e.g.</i> , please, thank-you; and (5) play organizers, <i>e.g.</i> , to give ideas about setting up games and rules	Dependent measures from direct observations consisted Clinical Evaluation of Language Fundamentals-4, Core Language Scores (CELF-4; Semel <i>et al</i> 2003); the Vineland Adaptive Behaviour Scale Teacher Report-Communication subtest (VABS; Sparrow <i>et al</i> 2006); and teacher ratings of classroom social behaviours [The Teacher Impression Scale (TIS); Odom and McConnell, 1997]	Peer intervention group improved more in initiations to peers during non-treatment social probes and during generalization probes in natural settings than the comparison group participants. Standard scores for language performance and communication (teacher report), and teachers ratings of peer network participants social communication behaviours greater for peer intervention group than for comparison group children
Locke <i>et al</i> ^[26] (2014)	United States	192 children with ASD, M = 6.1 yr (5-8 yr),	Strategies for Teaching based on Autism Research	ADOS, Differential Ability Scales-Second Edition (DAS-II; Elliott, 2009), Adaptive Behavior Assessment System-Second	Modest increases in global cognitive ability scores. Negligible changes in social functioning

		grades Kindergarten to second	(STAR), which incorporates discrete trial training (DDT, Smith 2001, from ABA), pivotal response training (PRT; Koegel <i>et al.</i> , 1989) and functional routines	Ed (ABAS-ii; Harrison and Oakland, 2003), Pervasive Developmental Disorder Behavior Inventory (PDDBI; Cohen and Sudhalter, 2005)-Teacher Form	
McKeating ^[28] (2014)	United States	Exp group: 39 children with ASD, M = 6.21 yr (5-7 yr). Comp Group: 39 children with other disabilities, M = 6.26 yr (5-8 yr) (Footnote: 73 teachers of children in sample)	Children received Itinerant, supplemental or full-time special education services	Inclusive Classroom Profile (ICP; Soukakou, 2010), Autism Evaluation Treatment Checklist (AETC; Rimland and Edelson, 1999), Teacher Perception Survey (TPS)	Children receiving full time special education services made substantially greater progress in sociability and behaviour, but not in communication, sensory or cognitive abilities, than children receiving supplemental and itinerant services. All children, regardless of placement achieved higher sociability scores at post-test. Teacher perceptions of inclusion predicted higher ATEC scores
Pellecchia <i>et al.</i> ^[25] (2016)	United States	152 children with ASD, M = 6.0 yr (5-8 yr), grades Kindergarten to second	Strategies for Teaching based on Autism Research (STAR), which incorporates discrete trial training (DDT, Smith 2001, from ABA), pivotal response training (PRT; Koegel <i>et al.</i> , 1989) and functional routines.	ADOS, Differential Ability Scales-Second Edition (DAS-II; Elliott, 2009), Adaptive Behavior Assessment System-Second Ed (ABAS-ii; Harrison and Oakland, 2003), Pervasive Developmental Disorder Behavior Inventory (PDDBI; Cohen and Sudhalter, 2005)-Teacher Form, Child Symptom Inventory-4 (CSI-4; Gdow and Sprafkin, 2002)	Modest mean change in DAS GCA scores. Several measures of adaptive behaviour; functional academics, health and safety, self-direction, social skills, and the overall adaptive composite predicted changes in DAS scores. Social anxiety symptoms predicted changes in DAS scores. Higher social anxiety symptoms and increase in student age significantly predicted a decrease in DAS scores
Sainato <i>et al.</i> ^[27] (2015)	United States	Exp group (Inclusive kindergarten program): 41 children with ASD, baseline: Age M = 75.7 mo. Comp group (Eclectic intervention): 21 children with ASD, baseline: Age M = 74.1 mo	Experimental group participated in general education classroom taught by trained teachers. Curriculum addressed core deficits of children with ASD using evidence-based strategies and behaviour management	Leiter International Performance Scale-Revised (Leiter-R; Roid, and Miller, 2002); Kaufman Test of Educational Achievement, Second Edition (KTEA-II; Kaufman and Kaufman, 2004); The Test of Language Development (TOLD-P: 3; Newcomer and Hammill, 1997); Vineland Adaptive Behavior Scales-Classroom Edition (Sparrow, Balla, and Cicchetti, 1985)	Experimental group made significant gains in nonverbal intelligence, academic achievement, and language scores compared with comparison group. Comparison group exhibited either no improvement or decreases. Both model and comparison groups demonstrated similar improvement in pre- and post-test outcomes on the Vineland Adaptive Behavior Scales-Classroom Edition (Sparrow <i>et al.</i> , 1985)
Whalen <i>et al.</i> ^[24] (2010)	United States	Exp group (preschool and K-1 students): 22 children with ASD, range 3 to 6 yr. Comp group (preschool and K-1 students): 25 children with ASD, range 3 to 6 yr	TeachTown: Basics', a CAI program that includes computer lessons and natural environment activities (Connection Activities) for developmental ages 2-7 yr. The student is taught in a discrete trial format where they receive reinforcement for correct responses. Treatment group used TeachTown: Basics for approximately 20 min a day on school days over three months	Peabody Picture Vocabulary Test, 3rd Edition (PPVT; Dunn and Dunn), Expressive Vocabulary Test (EVT, Williams, 1997), The Brigance Inventory of Early Development (Brigance, 2004), Childhood Autism Rating Scale (CARS), Ongoing Automatic Data Collection (TeachTown: Basics)	Children in the TeachTown: Basics group performed better across all language and cognitive outcome measures than the children in the control group. Additionally, students who used TeachTown: Basics demonstrated significant progress overall in the software and those students who used the program for more time demonstrated larger gains within the software and in outcome measures

¹Footnote: Other research populations examined separately not reported in this systematic review. DECA: Devereux Early Childhood Assessment; LAP-D: Learning Accomplishment Profile-Diagnostic; SRUSS: School Readiness Uniform Screening System; ASD: Autism spectrum disorder.

be a dramatic decrease in parent-teacher communication in kindergarten (formal primary school), as well as this contact being more negative compared to the supportive

environments of specialized preschools^[4]. Therefore, differences between preschools and mainstream primary schools are amplified for parents of children with ASD

through reduced explanatory communication and collaborative decision-making occurring between parents and teachers.

Individual factors affecting school transition

In total, five studies were included that examined the characteristics of children with ASD that may influence their adjustment to school in the first years. Three studies examined the functioning of children with ASD as well as their school and social engagement. Charman *et al.*^[19] assessed the functioning of children with ASD on entry to school and then again the end of their first year. They found that as a group the children's symptom severity did not change over the first year regardless of educational setting. Encouragingly, their language and communication improved, but there was no improvement in their sociability, sensory issues, cognitive development, or behaviour. In terms of the individual characteristics associated with change over time, children with better communication skills and lower symptom severity made more positive changes in their daily living skills in their first year of school^[19].

Jahromi *et al.*^[20] explored individual differences in self-regulation in 20 children with ASD compared with 20 of their typically developing peers, and how self-regulation related to their school and peer engagement in the first year of school. Prior to starting school, children's self-regulation and autism symptoms were assessed. The children's behaviour was assessed at the end of the year. The authors found that children with ASD had significantly less emotion regulation and effortful control than their typically developing peers. They also scored lower than their typically developing peers on many important components for school success, such as cooperative and independent class participation and prosocial peer engagement. For children with ASD, greater effortful control was associated with better prosocial behaviour^[20]. This suggests that these children might have a protective factor that will allow them to form better relationships with their teachers and peers, and perhaps therefore experience a smoother transition to the school environment.

Sparapani *et al.*^[21] developed a more generalised measure, the Classroom Measure of Active Engagement (CMAE) that addressed five areas of active classroom engagement including emotion regulation, classroom participation, social connectedness, initiating communication and flexibility^[21]. The authors reported that the children with ASD had substantial difficulties with active engagement in class and that this was not helped by participation in a special education class as opposed to a general education program^[21]. Observational data revealed that children with ASD spent less than half of the time in an emotionally-regulated state, being time productive and independently participating in classroom activities. Children rarely directed communications or used generative language and were only able to shift their attention to new tasks following verbal requests

about 50% of the time^[21]. One area where they showed greater flexibility was shifting to different materials. Children with better social skills had more positive active engagement in almost all areas measured, while externalising behaviours and higher repetitive and restricted behaviours were associated with less flexible classroom behaviour^[21]. Therefore, as a group, children with ASD had much difficulty with active classroom engagement, and children with poorer social skills and more repetitive and restrictive behaviours, and more externalised behaviours had the most difficulty with active engagement^[21].

Two studies were identified that examined the quality of student-teacher relationships in children with ASD. These studies indicated that children with ASD had substantially higher conflict and lower closeness with their teachers than typically developing or intellectually disabled peers^[22,23]. Eisenhower *et al.*^[22] examined the relationship between student-teacher relationship quality and externalizing behaviour problems for children with ASD in the first years of school. They found that children with ASD appeared to have poorer student-teacher relationships than those reported among typically developing children. Children in their study continued to have poor student-teacher relationships in new classrooms with new teachers, suggesting that the children's behaviour might be the more significant contributor to the student-teacher relationship. Prino *et al.*^[23] also found that teachers' relationships with children with ASD were more difficult than those they form with typically developing children, finding teachers reported higher conflict and less closeness with their students with ASD.

Overall, this research indicates that children with ASD appear to have externalising behaviours and self-regulation difficulties that affect their school engagement and their relationships with their teachers.

School-based interventions

Seven studies were identified that investigated the impact of school-based programs in the first years of school on children's functioning. Five of these studies examined ABA-based and teacher trained interventions in school. Whalen *et al.*^[24] examined discrete trial format Computer Assisted Instruction intervention; "TeachTown: Basics". This study found that children with ASD in the intervention program had higher language and cognitive skills than those who did not receive the intervention. However, this study did not examine broader social and behavioural skills.

Two studies evaluated the effectiveness of an ABA-based behavioural school-based intervention program called Strategies for Teaching based Autism Research (STAR) which involves intensive teacher training and support with the intervention focusing on three processes; discrete trial training, pivotal response training, and teaching within functional routines^[25,26]. This program also targeted language, academic, social

skills, and adaptive daily living skills. Locke *et al.*^[26] found that while children in the program had a modest improvement in their cognitive abilities, there was no improvement in their social functioning. Pellecchia *et al.*^[25] examined child characteristics that were associated with these cognitive gains. They reported that children in the program who had social anxiety symptoms, such as social avoidance and social fearfulness, made the least gains in their cognitive abilities. Given the fact that ASD and anxiety commonly co-exist, the authors suggested that it is important to identify children at risk of poor school adjustment and ensure that school-based intervention practices incorporate an anxiety-focus^[25].

Sainato *et al.*^[27] examined a school-based intervention with fully trained teachers that centred on full inclusion of children with ASD with their typically developing peers without individually assigned teaching aides. They developed a model kindergarten classroom that was organised to support a wide range of diverse learning needs for all children. Both children with ASD and typically developing peers experienced the same learning environment, curriculum and behaviour management. Children with ASD in the model classrooms made significant gains in a number of areas including performance IQ, academic achievement and language, while children in mainstream classrooms either did not improve or in some cases their scores decreased^[27]. However, there were no significant differences between the groups in adaptive behaviour and socialisation.

Another school-based ABA intervention program was evaluated by Grindle *et al.*^[10]. This program specifically focused on targeting socialisation in the second year of the intervention. Eleven children with ASD were in ABA-supported classrooms that approximated the mainstream timetable integrating children with their typically developing peers during breaks and extra-curricular activities. Children in the ABA-based intervention group made considerable gains in almost all areas except for socialisation in their first year^[10]. However, the focus of the intervention shifted in the second year to socialisation and communication, with the majority of children spending more time in mainstream classrooms. Children in the ABA-based program displayed a substantial improvement in daily living skills and socialisation skills in the second year, while their IQ remained stable. Overall, children in the ABA-based intervention made significantly more progress in their daily living and socialisation than children in the comparison group. However, there was no significant difference between the groups in academic progress. Nevertheless, after two years in the intervention program children with ASD remained predominately in the specialised support classrooms, only spending at most 6 h a week in mainstream classes^[10].

Consequently, it seems that children with ASD may require more than instruction and inclusion to improve their social skills and interactions with their typically developing peers. Only one study was identified that examined school-based interventions that used

combination of direct instruction and peer-mediated approaches. Kamps *et al.*^[11] randomised controlled study found that children from the intervention group were observed in natural settings to make more social initiations and frequency of communication with their peers than children in the education as usual group. Children in the intervention group also appeared to make greater gains in all areas of their language, communication and social skills than children in the comparison group^[11]. Therefore, it appears that children with ASD may make the greatest gains in their socialisation when they have direct and structured interactions with their typically developing peers that generalise out to other settings.

One final study was identified that looked at special education services in the first years more generally. McKeating^[28] found that children with ASD who attended full-time special education services made the largest gains in their behaviour and sociability, but not in communication, sensory or cognitive domains.

Therefore while school-based behavioural interventions appear to improve many skills and behaviours such as cognitive, language and daily living skills, children with ASD need to adjust and develop in the school environment, these interventions alone do not improve socialisation and peer inclusion for these children. There is a preliminary suggestion from Kamps *et al.*^[11] that school-based interventions incorporating direct instruction and peer-mediated interactions can assist children with ASD in developing vital social skills for a positive transition to the school environment.

DISCUSSION

Currently, there is a lack of systematic longitudinal studies evaluating the success of evidence based school transition programs for children with ASD. There are number of reasons for this. First, research on the school transition process for children with ASD is sparse and disparate, particularly in relation to school readiness. Only one study based on ABA specifically examined a school readiness intervention program^[17]. This study suggested that behavioural-based intervention programs in preschool may not provide children with ASD with the social skills they need to socialise with their peers in primary school. This was also evident in school based intervention programs in the early years of school. However, while these behavioural and instructional school-based intervention programs appear to improve skills in a number of areas for school success, such as learning and cognition, behaviour and adaptive living skills, they do not appear to target peer inclusion and socialisation^[10,25,26]. The results of one study suggested that peer modelling and instruction in the first year of school may help children with ASD form positive relationships with their peers and improve their socialisation^[11]. Therefore, incorporating peer modelling and social instruction into behavioural interventions may provide the best support for children with ASD when

transitioning to school.

Children with ASD present with unique social and communication deficits and behavioural difficulties, which can present unique learning and adjustment challenges^[21]. However, few studies have specifically investigated the impact of these difficulties on transitioning to school and engaging in the school environment. The few studies that have evaluated this suggest that children with ASD have poorer relationships with their teachers, poor self-regulation and difficulty being actively engaged in the classroom. This literature also established some individual child characteristics that may present as risk factors for poorer transition to school. Repetitive and restricted behaviours, social anxiety, less effortful control, poor social skills, and dislike of school appear to be associated with greater difficulty settling and engaging in school. The need for on-going and individualised school based interventions was also emphasised

Implications for school transition best practice

To date, no studies have specifically evaluated the success of a school transition program specifically for children with ASD. However, survey studies that have examined opinions of parents and teachers on best practices for school transition identified a number of key areas: (1) Transition team established; (2) parent involvement in planning; (3) child and parent visit to school; (4) visit support; (5) placement identification; (6) parent communication and information; (7) teacher sharing between preschool and kindergarten teacher; (8) child preparation (e.g., social stories); (9) decision support; (10) support identification; (11) transition administrator to supervise and evaluate the transition; and (12) peer, classroom and school preparation^[18].

The authors of these studies identified these relevant practices from the literature as well as government guidelines. Many school transition policies and guidelines are generic and rarely individualised to the child's particular needs^[1]. As can be seen from this review, children with ASD experience specific social, behavioural and communication difficulties that result in them being particularly vulnerable to a poor school transition. Additionally, teachers are more concerned about the ability of children with ASD to successfully transition to school than other children with disabilities. Therefore, children with ASD require comprehensive and individualised transition plans specifically tailored to suit their needs^[1]. However, there are elements that should also potentially be incorporated into all transition plans for children with ASD based on the current evidence. For example, while children's learning and academic development is currently monitored in most Australian schools through learning plans, social skills, communication and behaviour may not be adequately monitored. Therefore, transition plans for children with ASD should include regular monitoring and evaluation of a broad range of areas including active engagement,

socialisation and student-teacher relationships. Also, behavioural interventions with peer modelling may need to be incorporated into transition plans for these children. Finally, these programs need to be developed and implemented while children are in preschool and continue through the first year of school.

Implications for future research

There is a paucity of empirical studies that examine transition to school for children with ASD, particularly in longitudinal monitoring from specific school readiness preparation through to the end of the first few years of school^[22]. While a number of recent studies have examined specific school-based interventions, existing research on the process of primary school transition has tended to adopt cross-sectional survey based methodology^[2-4,18] rather than longitudinal designs with specific measurement of children's social-emotional, adaptive, and cognitive/academic progress. A large number of school transition practices have been identified and endorsed from these survey studies. However, the adequacy of these practices has not been established. There is a need for further research aimed at developing evidence-based strategies to enhance the school transition process and these strategies need to be formulated into guidelines and policies specifically for children with ASD due to their unique needs and difficulties. Additionally, while the academic progress of children is monitored through systems such as learning plans, for children with ASD more systematic monitoring of developmental and behavioural progress, using standardised instruments is needed to measure the effectiveness of well-developed, evidence-based individualised, long-term transition programs^[19].

Limitations

There were a number of limitations to this systematic review. The main limitation was the small number of studies available and the vast variability in the research design and quality of the studies included. The studies included were also from a limited number of countries, with papers predominantly from the United States. Given that school transition practices can vary substantially, different approaches and outcomes may not be addressed and examined in this systematic review. Additionally, publications that were not in English and single-subject case study design studies were excluded, therefore, some relevant studies may have been overlooked.

This systematic review suggested that children with ASD face more challenges, particularly in relation to social-emotional development and active engagement, when starting school than their typically developing peers and even their peers with disabilities. Like many systematic reviews there was substantial variation in the quality of studies and research design of the primary studies. Additionally, the number of studies investigating the school transition process for children with ASD

was disparate and sparse. Nonetheless, it appears both parents and teachers agree that structured and individualised transition plans are needed for children with ASD when starting school, but also during the first years. More structured processes at school and communication between schools, teachers and parents is needed to assist these children and their families adjust to the new school environment. This review also suggests that children with ASD experience more difficulty actively engaging in the classroom and forming positive relationships with their teachers and peers than their typically developing and developmentally delayed peers. Preliminary evidences suggests that individualised intervention programs targeting social skills, incorporating peer modelling, both prior to starting school but also school-based programs in the first years would assist children with ASD to adjust to and succeed in the school environment.

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COMMENTS

Background

Increasingly children with autism spectrum disorder (ASD) attend mainstream schools. Children with ASD experience social, communication and behavioural difficulties unique to their disability. The presence of these deficits indicates that children with ASD have greater risk of poor school outcomes. Children who experience a positive start to school are more likely to experience academic and social success.

Research frontiers

There is a paucity of empirical studies examining the transition to school for children with ASD. The research available is not disseminated and there is a lack of synthesis of the available studies. Thus there is a great need to establish and consolidate the current evidence on how and when children with ASD adjust to the new school environment.

Applications

This review can be used to guide practices during the school transition process for children with ASD.

Terminology

The terms used to describe early education programs (e.g., preschool, nursery school) and the first year of school (e.g., reception, prep, kindergarten) vary throughout the world. As the authors of this paper are situated in New South Wales, Australia, the term "kindergarten" is used to describe the first year of school and the term "preschool" is used to describe early education programs.

Peer-review

This is a well written and comprehensive review.

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