Title: Emotional Regulation and its Influence on the Experience of Stuttering across the Lifespan

Seth E. Tichenor, PhD, CCC-SLP (Corresponding Author; tichenors@duq.edu)

Assistant Professor

Duquesne University

Bridget M. Walsh, PhD, CCC-SLP

Assistant Professor

Michigan State University

Katelyn L. Gerwin, PhD, CCC-SLP

Post-Doctoral Research Associate

Michigan State University

J. Scott Yaruss, PhD, CCC-SLP, BCS-F, F-ASHA

Professor, Communicative Science and Disorders

Michigan State University

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Abstract

Purpose: This study evaluated relationship between *emotional regulation* (ER) and adverse impact related to stuttering across the developmental spectrum, in preschool and school-age children, adolescents, and adults who stutter. An additional aim examined how these variables relate to the ways that individuals approach speaking (i.e., their agreement on whether their goal is to speak fluently).

Method: Participants were the parents of 60 preschoolers and younger school-age children (ages 3-9), 95 school-age children and adolescents who stutter (ages 7-18), and 180 adults who stutter (ages 18 – 81). All participants completed surveys with age-appropriate measures examining ER and the adverse impact of stuttering. Older children and adults who stutter also answered questions regarding their goals when speaking. Multiple regression and ordinal logistic regression were used to examine relationships among ER, adverse impact related to stuttering, and goal when speaking.

Results: In preschool children, adverse impact was significantly predicted by a parent-reported measure of ER skills; in school-age children and adults, adverse impact was significantly predicted by measures of the ER strategies *cognitive reappraisal* (CR) and *expressive suppression* (ES). Less-frequent use of CR by adults was significantly associated with an increased likelihood of having "not stuttering" as a goal when speaking. Differences in the significance and magnitude of these relationships were found across the lifespan.

Discussion: For both children and adults who stutter, ER is a significant factor related to the adverse impact of stuttering; the relationship between ER and adverse impact may change over development. Accounting for individual differences in ER can improve understanding of *why* a

person copes with stuttering in the ways they do, and this has notable implications for individualizing intervention for both children and adults who stutter.

According to the Modal Model of Emotion (Barrett et al., 2007; J. J. Gross, 1998a), emotions arise when a person attends to, appraises (evaluates), and responds to their environment (J. J. Gross, 2014a; Lazarus, 1991). Emotional responses often influence the environment or situation in which the original appraisal occurred, and the influenced environment subsequently initiates further appraisal and further emotional responses. This loop of attending, appraising, and responding occurs across "experiential, behavioral, and neurobiological systems" (Barrett et al., 2007; J. J. Gross, 1998a, 2014a, p. 5). Although the term is defined differently by different researchers, emotional regulation (ER) commonly describes the process by which a person shapes, alters, or otherwise influences this loop of attending, appraising, and responding (J. J. Gross, 1998b, 2014b). Gross (2014a) described three core features of ER: activation of a regulatory goal (i.e., what a person wants to do or change), selection of a regulatory strategy or process (i.e., how a person will accomplish this regulatory goal), and modulation of the trajectory or outcome (i.e., monitoring the effectiveness of the regulation strategy with respect to the goal and making adjustments in subsequent strategy use). These core features of ER, and the Modal Model of Emotion more broadly, apply to both children and adults, though ER is a skill that develops throughout childhood and its development is influenced by both internal (e.g., cognitive and temperament) and external (e.g., social, familial, and cultural) factors (see J. T. Gross & Cassidy, 2019, for review). Some researchers conceptualize regulatory strategies or processes primarily in terms of effortful or conscious responses (see Rothbart et al., 2014); however, others describe how these regulatory strategies exist on a continuum from "explicit, conscious, effortful, and controlled…to implicit, unconscious, effortless, and automatic" (J. J. Gross, 2014a, p. 7; Gyurak et al., 2011; Gyurak & Etkin, 2014).

Regulatory strategies can be employed before, during, or after the situation that triggers the emotional experience (J. J. Gross, 2014b). Specific strategies for ER can involve *situation selection*, in which a person engages in specific actions to increase or decrease the likelihood of encountering a situation (Livingstone & Isaacowitz, 2015; Webb et al., 2018), and *situation modification*, in which a person directly modifies the circumstances of a situation before encountering it (J. J. Gross, 2014a, 2015). An example of *situation* selection would occur when a student avoids taking a course that requires giving presentations in front of the class due to a fear of speaking in public. An example of situation *modification* would occur if the student asks to present first because they recognize that presenting later would lead to increased fear or anxiety. In-the-moment regulatory strategies include directly altering how a person allocates attention during an emotional event (e.g., by distracting themselves with other thoughts or focusing or one particular thought), modifying how the person evaluates the situation (i.e., cognitive reappraisal), or inhibiting negative or positive emotions as they are being experienced (i.e., expressive suppression). Regardless of which specific strategy a person chooses to employ in a given situation, the consensus in the broader ER literature suggests that healthy ER is viewed as, "the result of flexibly choosing between regulation strategies to adapt to differing situational demands" (Sheppes, 2014, p. 127; Troy & Mauss, 2011).

The skill of healthy ER develops throughout childhood; and the specific ER strategies that a child uses will change as the child ages (J. J. Gross, 2015). One of the earliest-developing strategies is *attentional deployment*, or the ability to allocate or direct attention for the specific goal of influencing an emotional experience (J. J. Gross, 2014a). A common example of attentional deployment is *distraction*, defined as any strategy that involves thinking of or attending to something other than the situation or event that led to emotional arousal. Attentional

deployment develops starting in infancy; for example, research shows that young infants and toddlers can engage or disengage eye gaze more purposefully as they age (see Rothbart et al., 2014, for review). In preschool children, attentional deployment may take the form of simple behaviors, such as when children cover their eyes with their hands to shield themselves from the emotion-generating stimuli (Sala et al., 2014). In older children or adults, attentional deployment strategies may take the form of recalling memories or positive thoughts specifically to mitigate the negative emotional upheaval that they may be experiencing (J. J. Gross, 2014a).

The development of ER is closely related to the development of temperament in childhood (see Rothbart et al., 2014, for discussion). Rothbart and colleagues defined temperament as individual differences in *reactivity* and *self-regulation* (Rothbart, 2011; Rothbart & Derryberry, 1981). In this context, reactivity refers to a person's responses to the environment in motor, emotional, cognitive, and attentional domains (Rothbart, 2007; Rothbart et al., 2014). Self-regulation refers to "effortful attention that serves to modulate reactivity and organize change" (Rothbart et al., 2014, p. 306). When viewed through the lens of temperament, emotional regulation (ER) is seen as, "the modulation of a given emotional reaction, its inhibition, activation, or graded modulation" which occurs through effortful control (EC) mechanisms (Rothbart et al., 2014, p. 306). EC is thereby defined as "the ability to inhibit a dominant response to perform a subdominant response, to detect errors, and to engage in planning" (Rothbart & Rueda, 2005, p. 3). As EC skills develop, ER skills improve and children are better able to regulate their emotions via more flexibly approaching feared situations, leading them to more effectively inhibit undesired behaviors, thoughts, or feelings (Rothbart et al., 2014). EC is commonly considered to be a relatively stable trait by early childhood (Rueda, 2012); however, a growing body of research in adolescents has suggested that EC is still

developing (Laceulle et al., 2012; Vijayakumar et al., 2014). For example, adolescents and young adults who have significant adverse life experiences (e.g., poor peer and family environments) show far less-stable EC abilities than peers (Atherton et al., 2020). Moreover, the ability to adaptively engage in ER develops in a nonlinear way throughout childhood (Zimmer-Gembeck & Skinner, 2011). This nonlinearity occurs because adolescence is a time of transition, when adolescents may react more strongly to emotional situations than younger children (Stroud et al., 2009) while also experiencing mixed or negative emotions more frequently than adults (Riediger et al., 2014). Yet, children who are more reactive are less able to affectively regulate their emotions than children who are less reactive (Van Beveren et al., 2016). And, adults who have lower levels of negative affect more often use cognitive reappraisal strategies, while individuals with higher levels of negative affect more often engage in expressive suppression strategies (J. J. Gross & John, 2003). Thus, individual differences in temperament (reactivity and regulation abilities, as defined by Rothbart et al.) have been shown to influence which specific ER strategies a person is likely to select.

Notably, *expressive suppression* (ES) and *cognitive reappraisal* (CR) are two of the ER strategies that have been most thoroughly studied in individuals across the lifespan. ES is the process of "inhibiting ongoing emotion-expressive behavior" (J. J. Gross, 1998a; J. J. Gross & John, 2003, p. 349). CR is the process of "construing a potentially emotion-eliciting situation in a way that changes its emotional impact" (J. J. Gross & John, 2003, p. 349; Lazarus & Alfert, 1964). An example of ES would occur when a person remains outwardly cheerful and lighthearted even when feeling sad and disappointed as they interact with a person who turned them down for a date. An example of CR would occur when the person feels sad and disappointed about having been rejected but then recognizes in the moment that the person may

have turned them for a variety unrelated reasons. The ability to use both ES and CR strategies develops throughout childhood (see J. T. Gross & Cassidy, 2019; Silvers, 2020, for review). For example, children aged as young as 5 can be observed to use CR (Sala et al., 2014); Rapidly developing executive functioning skills in preschool children also enable the concealment of negative emotions via ES (J. T. Gross & Cassidy, 2019; S. Williams et al., 2016). Thus, considering the development of ER strategy use can provide further context and insight into how children manage their emotions as they age and experience other life difficulties.

Both ES and CR can be beneficial or not, depending upon the context, time-point, and population (see J. J. Gross, 2002; J. J. Gross & Thompson, 2007, for reviews). Overall, however, ES is typically associated with experiencing fewer positive emotions (J. J. Gross, 1998a; Stepper & Strack, 1993) and increased sympathetic nervous system activity (Demaree et al., 2006; J. J. Gross, 1998a; J. J. Gross & Levenson, 1993, 1997; Harris, 2001; Richards & Gross, 2000). Individuals who more often use ES as a regulation strategy experience more negative emotions and even characteristics of depression (J. J. Gross & John, 2003; Moore et al., 2008; Nezlek & Kuppens, 2008). In contrast, CR is typically associated with experiencing fewer negative emotions (Feinberg et al., 2012; Klimesch et al., 2007; Lieberman et al., 2011; Ray et al., 2010; Szasz et al., 2011), decreased sympathetic nervous system activity (Kim & Hamann, 2012; Shiota & Levenson, 2012; Stemmler, 1997), and fewer characteristics of depression (J. J. Gross & John, 2003; Nezlek & Kuppens, 2008). This is not to say that CR strategies are always helpful and ES strategies are always unhelpful. ES has been shown to be beneficial in reducing depression in certain cultures (Yuan et al., 2014), and CR has been shown to be less beneficial than ES in situations where emotions are strong (Sheppes et al., 2009; Sheppes & Meiran, 2007, 2008). The decision to engage in specific ER strategies is strongly influenced by cultural,

contextual, *and* individual experiential factors. These individual factors relate to who a person is, what has or has not previously worked for them for regulating emotions, and what their motivations or goals are within a given situation (see Sheppes, 2014; Sheppes et al., 2014, for review). Evaluating how these factors influence the process and development of ER in various populations can lead to a more thorough understanding of ER and a better understanding of the experiences of individuals within those populations (see J. J. Gross, 2014b, for discussion of ER and clincial populations).

Emotional Regulation and the Experience of Stuttering

Further specifying factors that influence how a person regulates emotion is relevant to the study and treatment of stuttering. People who stutter often experience elevated emotional reactions, such as fear, shame, anger, guilt, worry, etc. (Alm, 2004; Conture et al., 2013; Conture & Walden, 2012; Murphy, 1999; Tichenor & Yaruss, 2018, 2019a). These emotional experiences are individualized to each speaker; they develop over time as people cope with stuttering throughout their lives (Tichenor & Yaruss, 2018). A better understanding of how the use of specific ER regulatory strategies relates to the development of these negative emotions may lead to more effective treatment of the stuttering condition by further elucidating the reasons that a person develops their individual phenotype of the stuttering condition (see Tichenor & Yaruss, 2019b).

Researchers have used behavioral observation (e.g., Arnold et al., 2011; Johnson et al., 2010) and measures of physiology to inform the understanding of ER and related processes in people who stutter (e.g., Jones et al., 2014; Tumanova et al., 2020). The majority of these studies have examined EC, or other aspects of temperament more broadly, to explore ER skills in cross-sectional cohorts of preschool or school-age children who stutter. Anderson et al. (2003)

explored temperament characteristics in preschool children who stutter by using the Behavioral Styles Questionnaire (BSQ; McDevitt & Carey, 1978), a parent-reported measure of temperament characteristics. The authors found that preschoolers who stutter were judged to have lower adaptability skills; this may lead to greater negative emotions being experienced. Karrass et al. (2006) also used the BSQ and found that a group of preschool children who stutter were significantly more reactive and less able to regulate their emotions than a group of age- and sex-matched children who did not stutter. Similarly, Eggers et al. (2010) found that a group of 113 children who stutter aged 3 - 8 had significantly lower EC-related measures (Inhibitory Control and Attentional Shifting) than children who did not stutter on the Dutch version of the Children's Behavior Questionnaire (CBQ-D; Van den Bergh & Ackx, 2003). They hypothesized that lower EC would lead children who stutter to be more emotionally reactive than peers.

Despite the evidence that ER processes may be different in children who stutter compared to children who do not stutter, there is also strong evidence from longitudinal studies that have found no group differences in temperament between preschool children who stutter and preschool children who do not stutter (see Kefalianos et al., 2014, 2017; Reilly et al., 2013; Walsh et al., 2019). One recent exception to this trend comes from a longitudinal study showing that stuttering persistence was significantly associated with higher rates of internalizing behaviors and emotional reactivity in a cohort of 145 Dutch children, (Koenraads et al., 2021). These inconclusive between-group findings related to ER and temperament may be due to the inherent nonlinear development of ER and EC throughout childhood. Because ER is not stable throughout development, these mixed findings may be attributable to different underlying effects at different ages or due to methodological or sampling differences across studies. It is also plausible that the influences of ER on a person's experience of stuttering may naturally differ

across individuals as they react and cope with stuttering in their own ways throughout development (Conture & Walden, 2012). Further complicating the clarity of relationship between ER and stuttering is the open question of how adults who stutter regulate their emotions; such information would help to clarify individual differences in how adults and children who stutter experience and react to moments of stuttering. Thus, exploring ER processes simultaneously in children and adults who stutter may provide a more complete understanding of the relationship between ER and the broader experience of stuttering and the adverse impact experienced by people who stutter across the lifespan.

According to research on ER from outside of the field of stuttering, ER strategies are chosen based on specific regulatory goals; most often, strategies are selected in an attempt to *decrease* negative emotional experiences (see J. J. Gross, 2002, 2014a). Individual factors, such as past experiences and personal goals, strongly influence the decision to select one regulatory strategy over another (Sheppes, 2014; Sheppes et al., 2014). The same is likely to be true of people who stutter: people who stutter are likely to choose specific ER strategies based on their own prior experiences and personal goals in order to reduce negative emotional experiences. Exploring the specific ER strategies that people who stutter may select may help to elucidate how individual children, adolescents, and adults who stutter experience, approach, or manage moments of stuttering, and the consideration of individual differences in selection strategies may yield greater specificity than broader group comparisons. There are glimpses in recent stuttering literature of the potential impact that individualized goals can have on a person's experience of stuttering. In a sample of over 500 adults who stutter, Tichenor and Yaruss (2019a) found that a person's goal when speaking significantly predicted both the specific forms and degree of adverse impact that the person experienced related to stuttering: Adults whose goal was to not

stutter (as opposed to stuttering more openly or saying what they want to say regardless of whether or not they stuttered) were much more likely to experience shame, guilt, and embarrassment associated with their stuttering. The reverse was also true: adults whose goal was to stutter more openly and say what they want to say were much more likely to experience *less* adverse impact related to stuttering. Exploring ER strategies in people who stutter may therefore yield a better understanding of how individual speakers make decisions about how they approach speaking and how they attempt to manage moments of stuttering. For example, because ES may be a less optimal ER strategy with more negative sequelae (J. J. Gross, 2014a), selecting ES may be associated with (a) more often having the goal of not stuttering when speaking and (b) experiencing greater adverse impact related to stuttering. Conversely, because CR may be a more optimal ER strategy with less negative sequelae (J. J. Gross, 2014a), selecting CR as an ER strategy may be associated with (c) less often having the goal of not stuttering when speaking and (d) experiencing less adverse impact related to stuttering.

Taken together, results from the general ER literature suggest that people employ different regulatory strategies depending on contextual and personal factors. Because stuttering research has largely evaluated ER processes via group perspectives (i.e., without considering individual strategy selection), the relationships among ER, adverse impact related to stuttering, and goals when speaking are still unclear. Based on the way that a person's age, goals, and experiences related to speaking and stuttering might be associated with the specific ER strategies that they select, the overall purpose of this study was to quantify the relationship between ER, goals when speaking, and adverse impact related to stuttering across the developmental spectrum. Specific aims of this study were: (a) to describe the relationship between parent-reported ER and adverse impact related to stuttering in preschoolers and younger school-age

children who stutter; (b) to evaluate the relationship between two well-studied ER strategies (CR and ES) and adverse impact related to stuttering in cross-sectional cohorts of older children and adults who stutter; and (c) to explore individual differences in goal when speaking based upon ER strategy use in older children and adults who stutter.

METHOD

Participants and Procedures

This study involved survey data from 335 participants, including adults who stutter, children who stutter, and parents of children who stutter. The surveys, described below, included the following published instruments: the *Emotional Regulation Questionnaire* (ERQ; J. J. Gross & John, 2003), the *Emotional Regulation Questionnaire for Children and Adolescents* (ERQ-CA; Gullone & Taffe, 2012), and the age-appropriate version of the *Overall Assessment of the Speaker's Experience of Stuttering* (OASES-S for school-age children or OASES-T for teens; Yaruss & Quesal, 2016; Yaruss & Yaruss, 2021). Parents/caregivers also completed the Emotional Regulation Checklist (ERC; Shields & Cicchetti, 1997) as well as a new version of the OASES for parents of young children who stutter (OASES-E-P; Yaruss & Yaruss, 2021). Parents/caregivers of children who stutter and adults who stutter answered demographic questions about age, therapy history, self-help/support participation, etc. Adults and children aged 10 and above who stutter also answered questions regarding their goals when speaking (Tichenor & Yaruss, 2019a). A total of 180 adults who stutter completed the ERQ. Of those, 116 provided information about their goal when speaking and 84 completed the OASES-A. A total of 95 school-age children and adolescents (ages 7-18) completed the age-appropriate OASES-S or OASES-T. Of children aged 10 and up (n=67), all provided information about their goal when speaking and completed the ERQ-CA. The parents of 32 preschool children who stutter (ages 3-

6) completed the OASES E-P and the ERC; The parents of 28 young school-age children who stutter (ages 7-9) completed the ERC. Thus, the total sample size of child, adult, and parent data presented in this study was 335 (180 adults who stutter, 95 school-age children and adolescents, 60 parents of preschoolers and children aged 3-9 years). All adults who stutter in this study reported that they considered themselves people who stutter. All children in this study were reported by their parents to be children who stutter. For the child participants, parents reported that 114 (89.8%) had been formally diagnosed as stuttering by a speech-language pathologist or some other professional. Consistent with prior research (Tichenor & Yaruss, 2019a; Yaruss et al., 2002), most preschool children (75.0%), school-age children and adolescents (94.7%), and adults (89.9%) indicated a history of treatment for stuttering; fewer preschool children (18.2%), school-age children and adolescents (23.0%), and adults (61.4%) had participated in self-help/support for stuttering. Parental reports revealed that several preschool and school- age participants exhibited concomitant speech or language diagnoses. For preschool children, 7 (21.9%) were reported to have speech sound deficits and 2 (6.3%) were reported to have language deficits. For school-age children, 33 (34.7%) were reported to have speech sound deficits, 5 (5.3%) were reported to have language deficits, 2 (2.1%) were reported to have apraxia of speech, and 1 (1.1%) was reported to have both language and speech sound deficits. Concomitant neurodevelopmental and psychiatric diagnoses, along with demographic information reported by parents and participants, are included in Table 1. Demographic information for all children and adults who stutter can also be found in Table 1.

All child participants from this study were recruited as part of a larger, longitudinal study on the development of adverse impact in children who stutter led by the Developmental Speech Laboratory at Michigan State University. No data from these children have yet appeared in prior

publications. Of the 180 adult participants who stutter, 103 were unique to this study while 77 had completed other surveys in the ongoing survey project relating to individual differences in adverse impact from both the Michigan State University Spartan Stuttering Laboratory and the Duquesne University Life Impact of Speech and Stuttering Laboratory (see Tichenor et al., 2021; Tichenor & Yaruss, 2019b, 2019a, 2020c, 2020b, 2020a). Participants were recruited using a mix of convenience sampling and snowball sampling in which recruitment cascades via multiple distribution channels (Goodman, 1961). Participant lists from prior surveys, advertisement via social media outlets, word-of-mouth, and distribution of information to speech-language pathologists, specialty stuttering clinics, and national and international stuttering associations, were all used to recruit respondents. Recruitment partners were asked to share the survey with as many adults and families of children who stutter as possible to encourage a broad sampling of backgrounds and experiences. Because recruitment was conducted in these varied ways, it is impossible to determine how many parents of children or adults were ultimately contacted. Thus, response rates cannot be calculated.

The surveys were all conducted via the Internet using Qualtrics (Qualtrics, 2021). All adult participants and parents of child participants provided informed consent before receiving and completing the surveys. The adult data collection was deemed exempt from institutional review by the Michigan State University Human Subjects Research Protection Office under statute 45 CFR 46.101(b) 2 of the Federal Policy for the Protection of Human Subjects. The child study was approved by institutional review by the Michigan State University Human Subjects Research Protection Office (Study#00001704).

The Surveys

Multiple Qualtrics surveys were created to collect the data reported in this paper. Using multiple shorter surveys encouraged a higher response rate by facilitating completion of each survey while limiting fatigue and attrition. The number of surveys completed by each participant differed depending upon their age.

The *Overall Assessment of the Speaker's Experience of Stuttering* (OASES; Yaruss & Quesal, 2006, 2016) was used to assess the impact of stuttering on each participant's life. The OASES is based on the World Health Organization's *International Classification of Functioning, Disability, and Health* (ICF, WHO, 2001); it asks people who stutter about their reactions to stuttering, how much stuttering negatively impacts their communication in daily situations, and how much their stuttering negatively affects their quality of life. The OASES is currently available for three age groups: School-age (OASES-S; ages 7-12), Teen (OASES-T; ages 13-17), and Adult (OASES-A; ages 18 and above). Response forms for these three age groups have been shown to be a reliable and stable measure of the impact stuttering has on a person's life. A draft version of the Early Childhood OASES response form for parents (OASES-E-P; ages 3-6) was used to gather information about parents' perceptions of how stuttering affects their children's lives. Although the OASES-E-P is still in the validation stage, it was judged to be appropriate for use in this study because it examines the same constructs as other versions of the OASES (including versions using parent reports), which have shown strong reliability and validity in numerous studies. The OASES-E-P is structured in the same fashion as other OASES response forms. It is comprised of 38 questions across four sub-sections (general information, reactions, communication in daily situations, and quality of life), and scores for each sub-section and total score are also calculated in the same fashion as other OASES, reflecting an average of items completed in each section. All OASES response forms were scored in accordance with

instructions, and the OASES total score (a global measure of adverse impact related to stuttering in which higher scores indicate greater adverse impact) was used in the ordinal and multiple linear regression analyses described below.

The *Emotional Regulation Questionnaire* (ERQ; J. J. Gross & John, 2003) was used to assess an adult participant's tendency to engage in either expressive suppression (ES) or cognitive reappraisal (CR) through 10 questions using an 7-point agreement Likert scale. The ERQ has been shown to be a reliable and stable measure of both ES and CR in numerous samples (see Aldao et al., 2010, for review). An adapted child-version of the ERQ (ERQ-CA; Gullone & Taffe, 2012) was given to children aged 10-17 years and scored via instrument instructions. It contains child-friendly wording and measures the same constructs as the ERQ via a 5- point Likert scale. The ERQ and ERQ-CA were scored in accordance with instructions, and both ES and CR average scores were used in the ordinal and multiple linear regression analyses.

The *Emotional Regulation Checklist* (ERC; Shields & Cicchetti, 1997) was used to assess preschool (age 3-6) and younger school-aged (age 7-9) children's ER skills. The ERC consists of two sub-scales: lability/negativity and emotion regulation. But, ERC items are often scored together to form a mean score where higher scores indicate better ER skills (Schwartz & Proctor, 2000). The ERC has been shown to be a stable measure of ER in preschool and school-age children in multiple samples (Danisman et al., 2016; Reis et al., 2016; Shields & Cicchetti, 1997). ERC mean score was used as a predictor in the multiple regression equations for this age group. Measuring children's ER skills via parent report was necessary given that this survey study did not allow direct observation of children's ER strategies.

For participants who stutter aged 10 years and up, *goals when speaking* were explored using two agreement-scale Likert-based questions: "My goal when speaking is to not stutter" or

"My goal when speaking is to stutter openly and not do anything to try to hide it." These two questions come from a study by Tichenor and Yaruss (2019a) involving more than 500 adults who stutter which showed that the construct *goal when speaking* falls along a 2-factor structure (not stuttering vs. open stuttering). The two highest-loading items for each factor from our earlier study to adults and children who stutter in the present study to investigate how goal when speaking relates to the type of regulatory strategy a person selects. The age at which these items were presented to participants (ages 10 and older) was arbitrarily chosen *a priori*; it will be used as a benchmark to build future work in this area with younger children.

Data Analysis

Multiple R packages were used for data manipulation, analysis, and visualization (Christensen, 2019; Curtin, 2018; Dowle & Srinivasan, 2021; Fletcher, 2012; Fox & Weisberg, 2019; Garnier et al., 2021; Hebbali, 2020; Kassambara, 2020; Mazerolle, 2020; Moon, 2020; Revelle, 2019; Wickham, 2016; Wickham et al., 2019; Xie, 2021; Zeileis & Hothorn, 2002). Though each of the instruments used in this study are supported by previously published reliability data in the broader research literature of their respective fields, internal consistency measures were conducted to examine the internal stability of the measures and factors within this sample of children and adults who stutter. Given the volume of data, this information is presented in Table 2. Internal consistency across the published measures, as indicated by Cronbach's alpha, ranged from poor to excellent. The lowest alpha was seen in Section I (General Information) of the draft OASES-E-P, suggesting that this section of the trial instrument OASES examines more than one construct. Because total scores on the OASES reflect an average of items across all sections, the effects of examining multiple constructs is mitigated. Still, analyses presented below were completed both including and excluding the

Section I data. No appreciable differences were found in either significance or effect size. As a result, data from the OASES-E-P Section I were included in the final presentation of results to maintain consistency with how other versions of the OASES were used in this study. Not counting that section of the OASES-E-P, internal consistency for the other measures used in this study were ranged from adequate to excellent.

Two multiple linear regression equations were used to evaluate whether total score on the ERC, age, or their interactions could predict adverse impact related to stuttering as measured by OASES-E-P Total Score (Model 1 – children aged 3-6 years) or OASES-S Total Score (Model 2 – children aged 7-9 years). Two additional multiple linear regression equations were used to determine whether CR, age, or their interaction could predict OASES-S and OASES-T Total Scores (Model 3 – children and adolescents aged 10-18 years) and OASES-A (Model 5 adults aged 18 and older). Finally, two multiple linear regression equations evaluated whether ES, age, or their interaction could predict OASES Total Scores (Model 4 – children and adolescents aged 10-17 years) and (Model 6 – adults aged 18 and older). Note that the OASES-S and OASES-T Total Scores were combined in Model 3 and Model 4 to increase statistical power and decrease the number of statistical tests. This is justifiable as the predicted variable (OASES Total Score) calculated from the OASES-S (ages 10-12) or OASES-T (ages 12-17) are directly comparable as averages. These models, ages, and measures are visualized in Figure 1.

Multicollinearity was assessed through variance inflation factors (VIF). No models demonstrated VIF values high enough to raise concerns about multicollinearity between age and the ER variables (see Kennedy, 2003; Neter et al., 1985). However, the interaction of age and ER-related measures were not included due to not having the adequate sample size of preschoolers and younger school-age children. The final ER-related predictor variables included

CR in children aged 10 - 17 (*M* = 3.31*, SD* = .72), CR in adults (*M* = 4.78*, SD* = 1.11), ES in children aged 10 - 17 (*M* = 2.62*, SD* = .93), and ES in adults (*M* = 3.69*, SD* = 1.48). ERC mean total score was also investigated in children aged 3 - 6 (*M* = 3.07*, SD* =.23) and in children aged 7 - 9 (*M* = 3.18*, SD* = .22). These ER predictors and age were also investigated for linearity, normality of residuals, homoscedasticity, and the presence of influential values via diagnostic plots in accordance with the assumptions of linear regression. Diagnostic plots indicated that all predictors and outcome variables in each model showed a linear relationship that only deviated in the extreme tails. Likewise, all errors were judged to be normally distributed, with only slight deviations of normality in upper and lower tails. All predictors in all six models also demonstrated residuals that had a constant variance (homoscedasticity) and independence of residual error terms (i.e., no observation was more than 3 times the mean, see Cook, 1979). See supplemental data for more information on diagnostic plots. The outcome variables in all multiple regression models were the OASES-E-P (*M* = 2.14*, SD* = .56), OASES-S (*M* = 2.14*, SD* = .57), OASES-T (*M* = 2.42 *SD* = .53), or OASES-A (*M* = 2.68*, SD* = .69). Missing data were deleted listwise from the regression equation results because listwise deletion is unbiased when the probability of complete cases is independent of the outcome variable (Bartlett et al., 2014; Newman, 2014; White & Carlin, 2010), the exact circumstance in this study.

To investigate individual differences in ER strategy use as a function of a person's goal when speaking, ordinal logistic regression (ordered logit/proportional odds model) was performed (R. Williams, 2016). Ordinal logistic regression was selected because it is a useful analytical approach for analyzing Likert data as a function of continuous or categorical predictors, while accounting for the ordered nature of the dependent data (R. Williams, 2006, 2016). Ordinal logistic regression, which has proven useful for differentiating individual

differences in the experience of stuttering in previous literature (Tichenor & Yaruss, 2019a), is also more powerful than multinomial regression for detecting underlying patterns of ordered data (Barry, 2017). Four models were built: CR strategy use predicting goal when speaking (Model 7 – children aged 10-17 years) and (Model 8 – adults aged 18 and older) and ES strategy use predicting goal when speaking (Model 9 - children aged 10-17 years) and (Model 10 – adults aged 18 and older). The assumption of parallel lines (proportional odds assumption) was tested for each model using the likelihood ratio test of cumulative link models (Christensen, 2019). The assumption was considered to have been met for all four models because there was no significant difference between each model and a null model at $p < .01$ (Allison, 1999).

Results

Results from the analyses are reported below in terms of the three research questions: To describe relationship between parent-reported ER and adverse impact related to stuttering in preschoolers and younger school-age children who stutter; To evaluate the relationship between adverse impact related to stuttering and two ER strategies (CR and ES) in cross-sectional cohorts of older children and adults who stutter; To explore the relationship between individual differences in goal when speaking and ER strategy use in older children and adults who stutter.

ER and Adverse Impact of Stuttering

Preschool and Younger School-aged Children

In children ages 3 through 6 (Model 1), ERC and Age together explained a significant amount of the variance of OASES-E-P Total Score, $F(2,26) = 9.703$, $p < .001$, $R^2 = .43$, $R^2_{\text{Adjusted}} = .38$, $f^2 = .61$, a large effect size (Cohen, 1988). More detailed analyses (significance of predictors) revealed that the significant relationship with OASES-E-P total score was seen for ERC Total Score but not for age, indicating that higher ERC mean total scores were significantly

associated with decreased OASES-E-P Total Score or less adverse impact. The raw data reflecting the relationship between ERC mean Total Score and OASES-E-P Total Score in children aged 3-6 are shown in Figure 2a, which also contains a plotted regression line with standard error shaded to aid visualization of the relationship. For children ages 7 through 9 (Figure 2b), Model 2 ERC and Age together explained a significant amount of the variance of OASES-S Total Score, $F(2,32) = 4.857$, $p = .014$, $R^2 = .23$, $R^2_{\text{Adjusted}} = .19$, $f^2 = .30$, a medium effect size (Cohen, 1988). Age significantly predicted OASES-S Total Score where older ages were significantly associated with higher OASES-S Total Score (greater adverse impact); ERC mean Total Score did not significantly predict OASES-S Total Score. Specific information about all regression models can be found in Table 3.

Children and Adolescents Aged 10-18 and Adults

Model 3 (CR and age in children and adolescents aged 10-17 years) did not explain a significant amount of the variance of OASES Total Score, $F(2,57) = 1.236$, $p = .298$, $R^2 = .04$, $R^2_{\text{Adjusted}} = .01$, $f^2 = .04$. Model 4 (ES and age in children and adolescents aged 10-17) explained a significant amount of the variance of OASES Total Score, $F(2,57) = 6.634$, $p = .003$, $R^2 = .19$, $R^2_{\text{Adjusted}} = .16$, $f^2 = .23$, a medium effect size (Cohen, 1988). More frequent use of ES as an ER strategy was significantly associated with higher OASES Total Scores or greater adverse impact in children and adolescents aged 10-17 years. Age was not significantly predictive. The raw data reflecting the relationship between CR/ES and OASES Total Score in children and adolescents aged 10-17 is visualized in Figures 3a and 3b. Model 5 (CR in adults) explained a significant amount of the variance of OASES Total Score, $F(2,59) = 4.99$, $p = .010$, $R^2 = .15$, $R^2_{\text{Adjusted}} = .12$, $f^2 = .18$, a medium effect size (Cohen, 1988). Model 6 (ES in adults) explained a significant amount of the variance of OASES Total Score, $F(2,59) = 4.89$, $p = .011$, $R^2 = .14$, $R^2_{\text{Adjusted}} =$

.11, f^2 =.17, a medium effect size (Cohen, 1988). Less frequent use of CR as an ER strategy and more frequent us of ES as an ER strategy were both significantly associated with higher OASES Total Scores or greater adverse impact in adults. Age was not significantly predictive in either model. The raw data for CR and OASES Total Score in adults, as well as the raw data for CR, ES, and OASES Total Score, is visualized in Figures 3c and 3d. Specific results for each Model are provided in Table 3.

ER Strategy Use and Goal When Speaking

CR and ES strategy use, measured via the ERQ (for adults) or ERQ-CA (for children and adolescents aged 10-17 years), were used to predict goal when speaking ("My goal when speaking is to not stutter"). Equations using the goal of more open stuttering when speaking are not presented to limit redundancy because they indicated the opposite patten of results. A 1-point increase in CR mean score on the ERQ significantly increased the odds of an adult indicating that their goal when speaking is to not stutter by .60 at a 95% CI (range: .44 – .83) (Note that odds less than 1 indicates a decreased probability of occurrence). A 1-point increase in ES mean score on the ERQ non-significantly increased the odds of an adult indicating more agreement that their goal when speaking is to not stutter by a non-significant degree of 1.04 at a 95% CI (range: .82 – 1.31). Both child/adolescent models indicated nonsignificant predictions. A 1-point increase in CR mean score on the ERQ-CA increased the odds of a child or adolescent indicating more agreement that their goal when speaking is to not stutter by .77 at a 95% CI (range: .41 – 1.42). A 1-point increase in ES mean score on the ERQ-CA increased the odds of a child or adolescent indicating more agreement that their goal when speaking is to not stutter by 1.25 at a 95% CI (range: .77 – 2.06). Because odds are difficult to interpret intuitively, the ORs were mathematically transformed into probabilities, and CR regression equations were plotted in

Figure 4. The lighter lines (yellow and green) indicate a child, adolescent, or adult who is more likely to engage in CR as an ER strategy. The darker lines (purple) indicate a child, adolescent, or adult who is less likely to engage in CR as an ER strategy. ORs from the ES ordinal logistic regression equations were not mathematically transformed or plotted as those were not significant predictors in both groups. As can be seen in Figure 4a, an adult who stutters who is more likely to engage in CR as an ER strategy is less likely to report that their goal when speaking is not to stutter. Conversely, an adult who stutters who is less likely to use CR as an ER strategy is more likely to report that their goal when speaking is not to stutter. A similar cross over effect can be seen visually in the relationship between CR use and goal when speaking in children and adolescents (Figure 4b), though this prediction did not reach significance (95% CI range: .41 – 1.42)

Discussion

The purposes of this paper were to (a) describe the relationship between parent-reported ER and adverse impact related to stuttering in preschoolers and younger school-age children who stutter; (b) to evaluate the relationship between adverse impact and the two ER strategies of cognitive reappraisal (CR) and expressive suppression (ES) in cross-sectional cohorts of older children, adolescents, and adults who stutter; and (c) to explore individual differences in a person's goal when speaking based upon ER strategy use. Results indicated that higher parent-reported ER skills were significantly associated with lower parent-reported adverse impact related to stuttering in preschoolers. A similar relationship was not seen in younger school-age children who stutter, despite the finding that both groups on average experienced significant degrees of adverse impact as measured by the OASES. In older children, adolescents, and adults who stutter, more frequent use of ES was significantly associated with greater adverse impact

related to stuttering. More frequent use of CR was significantly associated with less adverse impact related to stuttering in adults but not older children and adolescents who stutter. This pattern of findings supports the notion that parent-reported ER and specific ER strategies are strong predictors of adverse impact related to stuttering. Yet, our cross-sectional data spanning preschool-aged children to adults shows differences in both the significance and magnitude of the relationships between ER and adverse impact related to stuttering in children and adults.

Past studies have shown that some groups of young children who stutter may be less able to regulate their emotions than matched groups of young children who do not stutter (Anderson et al., 2003; Karrass et al., 2006), though other research has not reported such effects (see Eggers et al., 2021; Kefalianos et al., 2014, 2017; Reilly et al., 2013; Walsh et al., 2019). In line with this pattern of mixed results, our data found differences across the age ranges in whether ER significantly predicted adverse impact related to stuttering. Age was only predictive of ER with children aged 7 to 9; for other age groups, a predictive relationship involving age was not found. Instead, parent-reported ER or ER strategy use was more predictive of adverse impact related to stuttering than age. Given that age and ER skills or strategies never demonstrated high degrees of multicollinearity, this null result of age cannot be explained by model complexity. One explanation for these differences may be that the development of ER is a nonlinear process throughout childhood (Zimmer-Gembeck & Skinner, 2011). Prior research has shown that various factors influence ER strategy selection, including culture, parenting styles, peer or social group influences, and characteristics of the child (e.g., cognitive skills and temperament) (J. T. Gross & Cassidy, 2019). Future research may be able to better account for these myriad factors to more clearly elucidate the relationship between adverse impact related to stuttering and ER throughout childhood. Moreover, using beneficial ER strategies can be difficult even for

typically developing children as they transition into adolescence (Stroud et al., 2009). This may align with the fact that ER did not significantly predict adverse impact in children aged 7 – 9. Living with the stuttering condition may present these children who stutter transitioning to adolescence with even greater difficulties managing emotions related to stuttering, speech, or communication-related activities. As a result, some of the differences in our findings across ages may be attributable to the fact that participants were cross-sectionally sampled at different stages of development at times when the unique contributions of living with stuttering and managing emotions may intersect in different ways. In other words, the relationship between age, ER, and adverse impact related to stuttering may naturally change throughout a person's development, and clinicians should not assume adult-like relationships between these constructs in children who stutter.

The possibility that some of the different findings between ER and adverse impact related to stuttering across age ranges may be attributed to different stages of development is also supported by the similarity of patterns in the results regarding goal when speaking. The engagement in ER strategies helps to explain adults' goal when speaking. More frequently electing CR as a regulatory strategy was associated with a significantly reduced likelihood that an adult's goal when speaking was to not stutter. This trend did not reach significance in school-aged children and adolescents. However, the same cross-over pattern between increased or decreased CR and having a goal of not stuttering is visible in the probability plot in Figure 4. If adverse impact related to stuttering does change or develop throughout childhood, then our finding of a similar (though non-significant) relationship between CR and goal when speaking in these younger individuals is not surprising. Future longitudinal work in this area should determine whether such differences among adverse impact, ER, and goal when speaking across

ages are representative of developmental changes or differences across children and adolescents who experience stuttering differently.

Clinical Implications

Considering the relationship between individual differences in ER strategies and adverse impact related to stuttering has critical clinical implications. As noted above, ER is the process of shaping, altering, influencing emotions, most often to reduce the severity of negative emotions (J. J. Gross, 2014a). This definition of ER highlights the value of not only understanding *what* speakers are doing when speaking (e.g., the well-documented speech and related behaviors that people who stutter often demonstrate) but also *why* they are doing it (e.g., substituting a word when ordering at a restaurant because stuttering would increase negative emotions). This deeper understanding of how a client engages with the emotion surrounding moments of stuttering can help clinicians better understand their client's experiences.

Addressing many affective, behavioral, and cognitive reactions in stuttering therapy requires an understanding of the emotionality attached to them and the individual decisions that people who stutter may make in how they cope with stuttering (Tichenor et al., 2022). For example, covert stuttering can take many forms, including avoidance of words, sounds, or situations, as a speakers attempt to "pass" as a person who does not stutter (Constantino et al., 2017, p. 27; Douglass et al., 2018; Murphy, Quesal, et al., 2007). A child or adult might choose to engage in avoidance in order to prevent or minimize the emotional upheaval associated with a word, sound, or situation. Thus, avoidance can be seen as a stuttering-specific example of situation selection strategy use. Conversely, a person may choose not to avoid a moment of stuttering, opting rather to stay in a situation, because they realize that their message is worth saying despite the fact that they stuttered while conveying it. This would be an example of CR

because the speaker is actively re-framing the negative emotions they are experiencing into a more positive focus on communication. In short, a clinician who understands *why* their client chooses certain ER strategies for managing a moment of stuttering is better positioned to teach more adaptive methods of stuttering management. Such a clinician is also better positioned to charting a path toward reducing the negative impact of stuttering on a person's life.

One particularly useful tool for addressing poorer ER and mitigating adverse impact in stuttering therapy is desensitization. Desensitization is the process by which a person who stutters engages in fearful speaking-related activities with the goal of experiencing fewer negative emotions and, ultimately, learning to engage more easily with speech in the future (Brundage et al., 2006; Murphy, Yaruss, et al., 2007). Decades ago, Van Riper described effective desensitization in stuttering therapy in a manner that is consistent with how current research describes effective ER. Van Riper stated, "Our purpose in desensitization therapy is to reduce the strength of the attendant emotional upheaval enough to enable the stutterer to learn new ways of coping with the expectancy and experience of broken words" (Van Riper, 1982, p. 267). Present findings shed light on how these manifestations may develop differently for different individuals who stutter, given that adults who less often engaged in CR as an ER strategy were more likely to have the goal of not stuttering when speaking. Repeatedly experiencing difficulty speaking (Perkins, 1990; Tichenor & Yaruss, 2019b) is, for many people, associated with the development of fear, shame, embarrassment, and other negative reactions concerning speech or communication. These feelings become habitual, anticipated, and reinforced by repeated speech difficulties, and, as a result, a person may learn to avoid, push, or struggle in an attempt to cope with the sensation (or anticipation) of being stuck or unable to communicate as they wish (Constantino et al., 2017; Jackson et al., 2015; Tichenor et al., 2017;

Tichenor & Yaruss, 2018). Thus, these forms of adverse impact related to stuttering can meaningfully be viewed as resulting from non-optimal forms of ER. Exploring a client's experience of stuttering through the ways that they attempt to regulate their emotions during moments of stuttering or in different situations can directly lead to treatment that is more specifically targeted to each client's unique needs, history, personal characteristics, and goals.

Our findings therefore contribute to the growing body of research that highlights the benefits of holistic therapy for stuttering that addresses not only the more readily observed stuttering behaviors but also the burden that the condition has on the life of the person who stutters. Specifically, for older children and adults, the present data support the notion that formal strategies such as mindfulness training and other cognitive therapy techniques can be incorporated into therapy to mitigate adverse impact related to stuttering (Beilby et al., 2012; Blood, 1995; Boyle, 2011; Cheasman, 2013; Emerick, 1988; Gupta et al., 2016; Harley, 2018; Helgadóttir et al., 2014; Kelman & Wheeler, 2015; Menzies et al., 2009; Palasik & Hannan, 2013; Plexico & Sandage, 2011; Van Riper, 1973), particularly given that such therapy leads to more effective ER (see Farb et al., 2014, for review). Our data provide less clear therapeutic guidance for younger children who stutter; however, clinicians must still be cognizant that even young children who stutter can experience high degrees of adverse impact related to stuttering (De Nil & Brutten, 1991; Langevin et al., 2010; Vanryckeghem et al., 2005; Vanryckeghem & Brutten, 1997). Our results showed that not only do many children experience adverse impact as measured by OASES-E-P scores (M = 2.14, SD = .56), but that *individual* differences in ER strongly predicted the amount of adverse impact experienced in preschool children who stutter. This finding that stands in contrast to prior group studies suggesting that adverse impact develops only later in life (see de Sonneville-Koedoot et al., 2014; Reilly et al., 2013).

Limitations and Future Directions

Although this study involved participants from different age groups, data were drawn from a single timepoint for each participant. As such, care should be taken when interpolating what these data mean in a longitudinal or developmental context. We have attempted to be cautious in hypothesizing why older children's data were similar (though not identical) to those of adults who stutter. In future work, we will explore the relationship between ER and adverse impact longitudinally to observe interactions *within* individual children who stutter over time. Relatedly, our analyses indicated that age only predicted ER processes for children aged 7-9. Future work should consider larger groups of children across age ranges to explore potential interactions between age and ER in predicting adverse impact using a broader range of measures. Lastly, this study explored two commonly studied ER strategies (CR and ES); future work should also employ both quantitative and qualitative methods to explore the relationship between adverse impact and other ER strategies.

By design, this study did not explore potential relationships between ER strategies, adverse impact, and goal when speaking *in the context of* observably stuttered speech. Future research could explore relationships to overt speech, given that prior studies using behavioral and physiological measures in children who stutter have revealed differences in ER-related processes (see Walsh & Usler, 2019, for discsussion of physiology in relation to speech motor control). Such investigations are useful because behavioral and physiological measure can provide insights to more state-like ER in specific contexts, such as during ongoing speech production (Zengin-Bolatkale et al., 2015). For example, prior research has shown that rapid naming tasks increase sympathetic responses in young preschoolers who stutter (age 3) but not in older children (ages 4 – 5) (see Zengin-Bolatkale et al., 2015). Research has also shown that

sympathetic responses increase during observed moments of stuttering but not during perceptibly fluent utterances (Walsh & Usler, 2019) and that preschool children who stutter demonstrate higher skin conductance levels while producing a narrative (Jones et al., 2014). Finally, research has shown that lower EC strongly predicts increased stuttering severity in multiple cohorts of children (Kraft et al., 2014, 2018). Future research should therefore explore the relationships between ER strategies, observable stuttering severity, and physiology in both children and adults to better specify potential lead-in processes and immediate consequences of individual moments of stuttering.

Summary

This study evaluated the relationship between ER, adverse impact related to stuttering, and how individuals approach stuttering. Higher parent-reported ER skills in preschoolers were significantly associated with lower parent-reported adverse impact related to stuttering, yet this relationship was not significant in younger school-age children aged 7-9 years. Children and adolescents who stutter aged 10-17 years who engaged more often in ES as an ER strategy demonstrated significantly higher levels of adverse impact related to stuttering. This pattern was also seen in adults who stutter in this study. Adults who engaged in CR demonstrated both significantly lower adverse impact related to stuttering than adults who engaged less frequently in CR and a decreased likelihood of having the goal to not stutter when speaking. Older children and adolescents did not show these effects, however. These data suggest that ER is a significant factor related to the adverse impact of stuttering for both children and adults who stutter, and that the complex relationship between ER and adverse impact changes across development.

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Figure Captions

Figure 1. The age ranges of children and adults in the study are shown alongside the measures completed at varying ages. The models (1-6) illustrate what predictor and outcome variables comprise the multiple regression equations.

Figure 2. The predicted relationship between Emotional Regulation Checklist (ERC) mean total score and OASES Total Score (Early Parent or School-age) is visualized. ERC mean total score significantly predicted OASES E-P total score in preschoolers aged 3-6 but did not significantly predict OASES S total score in children aged 7-9. The colored band indicates the standard error in the prediction of the regression equation.

Figure 3. The predicted relationships between OASES Total Score (Adult, School-age, or Teen) and Cognitive Reappraisal or Expressive Suppression are visualized. Expressive Suppression significantly predicted OASES total score in Adults (F3d) and Children (F3b); More frequently using Expressive Suppression as an Emotional Regulation strategy was significantly associated with a higher degree of adverse impact in children and adults. Cognitive Reappraisal significantly predicted OASES total score in adults (F3c) but not in children or adolescents (F3a). More frequently using CR as an Emotional Regulation strategy was significantly associated with a lower degree of adverse impact in adults.

Figure 4. The predicted probability of having a goal when speaking of not stuttering (as measured by their agreement regarding how frequently they have this speaking goal) is predicted by the tendency to engage in Cognitive Reappraisal. Having a goal when speaking geared towards not stuttering (as opposed to more open stuttering) significantly decreased an adult's tendency to elect CR as an Emotional Regulation Strategy. This effect was not significant in children, though the pattern is visually similar to the adult data via the same cross-over pattern between low and high tendency to elect CR. Darker lines indicate lower tendencies to use CR while lighter lines indicate higher tendencies to use CR.