# Exposure to the Self-Face Facilitates Identification of Dynamic Facial Expressions: Influences on Individual Differences

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**Abstract**

There is a growing literature suggesting that the self-face is involved in processing the facial expressions of others. We experimentally activated self-face representations to assess its effects on the recognition of dynamically emerging facial expressions of novel faces. Moreover, we indexed individual differences in autism traits in our normal participants to investigate personal characteristics that increase response to this manipulation. Our results show that experimentally activating self-face representations facilitates facial expression recognition in that subjects required less affective perceptual information to reach a correct decision, and that the effect is more potent with individuals with higher autism traits. These data suggest that our ability to process facial expressions is strongly linked with the internal representations of our own faces.

*Keywords*: self-face, emotion, affect, embodied emotion, facial expression, priming, dynamic expression, autism

## Introduction

Within the vast repertoire of faces that we see, there is perhaps no face more relevant and personal than our own face. There is no other face with which we can have comparable lifelong and consistent experiences. While seeing and sensing one's own face enriches the internal representation of faces, it is the lifetime of social experiences with the faces of others that bring forth the functional utility of self-face representations. Through concurrent sensory-motor feedback each time we express emotions ourselves or respond to the emotions of others, we strengthen the representations of the self-face in a *social context* and bidirectionally link self-face representations to processing emotions of others. Our self-face feedback can affect our emotional experience (Dimberg, 1982; Dimberg & Petterson, 2000; Laird et al., 1994) and affect our interpretation of the emotions of others (Havas et al., 2009; Hennenlotter et al., 2008; Stel, van Dijk, & Olivier, 2009). Indeed, theories of empathy involving mirror neurons (Gallese & Umilta, 2002; Wolf et al., 2001), embodied cognition (Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005), and theory of mind (Meltzoff & Decety, 2003) further support the idea that processing facial expressions in others is tied to the underlying representations of our own faces (Niedenthal, 2007).

Our own faces have been shown to influence our processing of emotional expression in others in several ways. For example, the self-face has been *indirectly* shown to affect processing of ambiguous facial expressions. Neta and colleagues (2009) used electromyography to measure the corrugator supercilii muscles of participants viewing surprised faces and showed that increased muscle activity in one's own face predicted a negative bias when perceiving another's face whereas a decreased muscle activity predicted a positive bias. Impairments in facial expression recognition had been demonstrated by *direct* physical disruption of self-face movements caused by biting down on a pen (Oberman, Winkielman, & Ramachandran, 2007), as well as by the use of Botox injection to facial muscles, which impairs difficult-to-interpret facial expressions in particular (Davis et al., 2010). Taken together, these studies suggest that *inhibiting* self-face movements directly influences face emotion processing. The current study examined to what extent *activating* self-face representations can facilitate processing of others' facial expressions.

Recently, Li and Tottenham (in press) have experimentally primed subjects with self-face representations prior to a face emotion discrimination task and showed that the self-prime manipulation aided in the recognition of static images of facial expressions. In the current paper, we tested the effect of self primes on dynamically changing facial expressions. Several studies have shown that dynamic expressions enhance the sensitivity, intensity, and memory of facial emotions (Biele & Grabowska, 2006; Wehrle, Kaiser, Schmidt, & Scherer, 2000), and have been shown to activate face processing regions more robustly than static images (LaBar, Crupain, Voyvodic, & McCarthy, 2003). Furthermore, only dynamic facial expressions are capable of conveying three-dimensional facial information (O'Toole, Roark, & Abdi, 2002). Most important, however, is that dynamic displays can recreate the emergence of an emotional facial expression (in the current case, happy or angry) from a neutral facial expression. Thus, the first goal of the current study is to examine the effect of self-face priming on processing dynamic facial expressions of others.

Studies have shown that individual personality differences can significantly predict emotional interpretation of facial expressions (Neta, Norris, & Whalen, 2009). The second aim of the present study is to examine which personality traits predispose a subject to be particularly *responsive* to self-face priming. We focused on traits associated with Autism Spectrum Conditions (ASC) since there are known difficulties in facial expression processing in those with ASCs (Ashwin, Chapman, Colle, & Baron-Cohen, 2006; Philip et al., 2010; Wright et al., 2008). These traits exist on a continuum within typical healthy populations (Baron-Cohen) and thus allow us to examine how ASC traits influence facial expression processing (Wing, 1988). We chose the Autism Quotient (AQ) (Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001b) as our index of ASC traits as there exists evidence that high scores AQ scores are associated with poor facial expression processing (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001a).

In this study, we randomly assigned typical participants to the self or nonself conditions, to examine how self-primes influence performance on a dynamic facial expression judgment task. We predicted that the self-face prime manipulation would facilitate dynamic facial expression processing of others as it has been shown to do with static facial expressions. Moreover, we predicted that high AQ scores would be correlated with slower emotion processing as has been shown previously, and that "treatment" with the self-face prime would significantly mitigate those effects.

## Methods

### Participants

Sixty (34 female, mean age 19.6) healthy undergraduate students (38.3% Asian-American, 33.3% European-American, 8.33% Hispanic, 20% Other) participated for course credit. Participants were all initially assessed for right handedness as indexed by a modified version of the Edinburgh handedness inventory (Oldfield, 1979). Participants were also excluded based upon substance abuse issues, serious medical complications, epilepsy, or other neurological disorders. This study was approved by the University of California, Los Angeles Institutional Review Board.

**Design and Materials**

Participants were randomly assigned to either the self condition or nonself condition. To create the experimental conditions, participants in the self prime condition were shown a one-minute video clip of their own facial expressions, and participants in the non-self prime condition were shown a one-minute video clip of a different subject's face who was matched on gender and ethnicity. We chose to prime participants with videos as opposed to static images to capitalize on the rich, dynamic, and three dimensional expression of emotion that moving pictures can provide (Gibson, 1966; Dodwell, Humphrey, & Muir, 1987; O'Toole et al., 2002).

To create priming videos, we exposed participants to two separate emotion-inducing movie clips, each were three minutes in duration. The positively valenced clip was "The Best Bits of Mr. Bean", and the negatively valenced clip was "My Bodyguard" (PolyGram Entertainment, 1999; 20th Century Fox, 1980) shown in counterbalanced order. These movies have previously been shown to effectively elicit emotional expressions in the experimental setting (Li & Tottenahm, in press; Bensafi, Brown, Khan, Levenson, & Sobel, 2004; Gross & Levenson, 1995). While subjects watched these expression-eliciting movies, we recorded their natural emotional expressions. Participants were explicitly told that they will be recorded. They were instructed to ignore the camera and respond as they naturally would. We recorded the participants from a distance of 57cm in direct view of the front of the face at a resolution of 480 by 640 pixels using a Samsung digital camera. We extracted 30 seconds of the participant smiling and 30 seconds of the participant frowning from their recorded videos using Microsoft Movie Maker (we tried to obtain continuous emotional expression when possible) and produced two separate 60-second prime videos (positive and negative) in counterbalanced order. A participant randomly assigned to the self prime condition would view his/her own prime video, whereas a participant randomly assigned to the nonself prime condition would view another participant's prime video.

Participants then completed the Positive and Negative Affective Schedule (PANAS; Watson, Clark, & Tellegen, 1988), a 20-item self report questionnaire. The positive affect index reflects enthusiasm, alertness, and pleasurable engagement whereas the negative affect index reflect distress and unpleasurable engagement. This measure has been shown to be reliable for the positive and negative scales (Cronbach's $\alpha = .89$ & .85 respectively; Crawford & Henry, 2004). Participants were also administered the Spielberger State/Trait Anxiety Inventory (STAI-SA/TA; Spielberger, Gorsuch, & Lushene, 1983), which measures current and long-term anxiety in adults. Test-retest correlations for the state and trait inventories are respectively .40 and .86, and demonstrate adequate reliability (Rule & Traver, 1983; Tilton, 2008).

Following the primes, participants were administered the experimental emotion judgment task in which neutral faces (from the NimStim set) dynamically changed into a 'happy' or an 'angry' expression. Face stimuli (Tottenham et al., 2009) consisted of 13 European-American men and women, and 13 African-American men and women. Participants were instructed to decide whether the neutral face was becoming 'happy' or 'angry' as quickly and as accurately as possible. Each trial consisted of a stimulus "movie" composed of 20 separate images of an individual's face, morphed from neutral to the emotions 'happy' or 'angry' (Kirsh & Mounts, 2007). These movies played for 2200ms, with 300ms for the initial neutral image, and 100ms for each subsequent emotional image. For example, a 0% happy (100% neutral) face was displayed for 300ms, followed by a 5% happy (95% neutral) face for 100ms, and so forth.

Participants were exposed to two practice trials and 52 experimental trials (26 'happy', 26 'angry'), mixed in random order. The movie was 506 x 650 pixels and subtended approximately 17 x 22 visual degrees on the monitor. The experiment was conducted in E-Prime v.2 (Psychology Software Tools, Inc., 2002) on a PC desktop running Windows XP. Participants sat 57cm from an LCD monitor on a resolution of 1024 x 768 and a refresh rate of 60hz.

**Procedure**

Participants were first randomly assigned to the self or nonself conditions (Figure 1). Both groups viewed emotional movie clips to create the primes. Following the creation of the primes, the self-prime group viewed videos of their own faces while the nonself prime group viewed faces of different subjects. Participants were then administered questionnaires and given the experimental task. Participants responded bimanually on a USB keyboard.

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Insert Figure 1 about here

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## Results

**Reaction Time**

We conducted a repeated measures ANOVA with Prime (Self, Nonself) x Emotion Category (Happy, Angry) with Reaction Time (RT) as the dependent variable using only correct trials. We found a significant main effect of Prime ($F(1, 58) = 4.02$, $MSE = 269858.23$, $p = .05$, $\eta^2 = .07$) showing that the self prime group ($M = 1161.40$, $SD = 211.59$) was significantly faster compared to the nonself prime group ($M = 1351.61$, $SD = 481.17$) (Figure 2). That is, subjects randomized to the self prime condition required less affective perceptual information to reach a correct decision. We also found a significant main effect of Emotion Category, showing that happy emotion movies were recognized earlier than angry emotion movies ($F(1, 58) = 29.42$, $MSE = 6312.93$, $p < .01$, $\eta^2 = .38$).

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Insert Figure 2 about here

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**Accuracy**

We conducted a repeated measures ANOVA with Prime (Self, Nonself) x Emotion Category (Happy, Angry) with accuracy as the dependent variable. The accuracy means for both groups were high (Self: $M = 0.98$, $SD = 0.03$; Nonself: $M = 0.97$, $SD = 0.03$), and we did not find any significant main effects or interactions ($F(1, 58) = 1.853$, $MSE = 0.002$, $p > .05$, $\eta^2 = .031$).

**Mood Check**

To rule out the possibility that the obtained results were due to a change in the participants' mood rather than our priming manipulation, we administered both the PANAS and STAI inventories after the priming sessions.

Positive Affect scores between the self condition ($M = 26.94$, $SD = 7.56$) and the nonself condition ($M = 23.59$, $SD = 8.93$) showed no group differences $t(58) = 1.57$, $p > .05$. Negative Affect scores between the self condition ($M = 14.19$, $SD = 3.43$) and the nonself condition ($M = 15.86$, $SD = 4.98$) were also not different $t(58) = 1.52$, $p > .05$ between groups.

The STAI-SA state anxiety scores were not different for self condition ($M = 36.90$, $SD = 9.45$) and the nonself condition ($M = 39.14$, $SD = 10.08$) $t(58) = 0.89$, $p > .05$, nor were there any group differences in the STAI-TA trait anxiety scores $t(58) = 1.06$, $p > .05$ for the self condition ($M = 40.00$, $SD = 9.93$) and the nonself condition ($M = 42.79$, $SD = 10.45$).

**Individual Differences in Response to the Self Prime**

We next examined how the self prime influenced individual differences in facial expression processing. We were primarily interested in the AQ because it is a continuous personality measure in which high scores are associated with poor emotion processing. We compared the AQ score for the self prime group ($M$ = 15.71, $SD$ = 5.54) and nonself prime ($M$ = 16.24, $SD$ = 5.20) group and found no differences in AQ scores for the two experimental conditions $t(58) = 0.38$, $p > .05$ (Figure 3). We then conducted a repeated measures ANCOVA with Prime (Self, Nonself) as the between-group factor and Emotion Category (Happy, Angry) and AQ score (continuous) as the within subject factors, on the dependent variable of RT. We found as above a significant main effect of Prime ($F(1, 56) = 4.35$, $MSE = 226535.16$, $p < .05$, $\eta^2 = .07$). We also found a significant main effect of AQ ($F(1, 56) = 6.06$, $MSE = 226535.16$, $p < .05$, $\eta^2 = .10$) that was qualified by a significant interaction between Prime and AQ ($F(1, 56) = 8.23$, $MSE = 226535.16$, $p < .01$, $\eta^2 = .13$). Specifically, the interaction shows that greater AQ scores were associated with slower RT in the nonself prime group, but not in the self prime group (Figure 4). Moreover, there was a significant positive correlation between RT and AQ for the nonself prime group ($r = 0.50$, $p < 0.01$), but not for the self prime group ($r = -0.19$, $p > 0.05$).

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Insert Figure 3 about here

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Insert Figure 4 about here

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## Discussion

This study examined whether activation of self-face representation facilitates the processing of dynamic emotional facial expressions of others. We demonstrated that the self prime intervention increases the speed at which participants can recognize whether a neutral face transitioned into a happy or angry face, consistent with our previous work showing that activating self-face representations enhances the recognition of static facial expression processing (Li & Tottenham, in press). Because the faces were dynamic in nature, morphing from neutral to emotional, slower reaction times were indicative of subjects requiring more affective perceptual information to reach a decision about emotional expressions. Thus, the self-face prime was effective in helping subjects reach conclusions about facial expressions in the more subtle versions of facial expressions. These data are consistent with the hypothesis that priming an individual with his/her own face (relative to the face of another) activates a highly enriched visual, sensory, and motor representation of faces. The current study also investigated whether certain individuals would benefit most from the self prime manipulation. We showed that higher AQ scores resulted in slower recognition of facial emotions (that is, requiring more affective perceptual information on which to base their decision), but that the self prime "treatment" abolished that relationship and significantly aided in facial emotion recognition in those subjects. Taken together, this evidence supported our hypothesis that activating self-face representations can facilitate facial expression processing and abolish the slower emotion processing typically evidenced by individuals with higher AQ scores.

These results could not be readily attributed to effects of mood, as the PANAS and STAI were administered after the priming manipulation and showed that the self and nonself group scores did not differ significantly. Instructions, filming, and video processing were identical in each randomly assigned condition. Furthermore, we ruled out a speed/accuracy tradeoff strategy, as our analysis of accuracy did not show significant group differences (Self: *M* = 0.98, *SD* = 0.03; Nonself: *M* = 0.97, *SD* = 0.03).

This study adds to the emerging line of research examining the role of the self-face in social cognition. *Natural* processing of others' facial expressions triggers automatic mimicry of the expression in the self-face (Dimberg, 1982; Dimberg, Thunberg, & Elmehed, 2000; Meltzoff & Moore, 1977) and causes emotional mimicry in the perceiver (Hatfield, Cacioppo, & Rapson, 1994; Nummenmaa, Hirvonen, Parkkola, & Hietanen, 2008). *Inhibition* of the self-face reduces an individuals' ability to process facial emotions (Havas et al., 2009; Hennenlotter et al., 2008) and reduces empathy (Stel et al., 2009). The stimulation of self-face representations may correspond to an *amplification* of the neural substrates that have been traditionally associated with facial expression processing (e.g., the amygdala and fusiform gyrus), but may also include other regions involved in self-relevant processing (Northoff & Bermpohl, 2004; Northoff et al., 2006; Schneider et al., 2008; Seger, Stone, & Kennan, 2004) or social cognition (Dapretto et al., 2006; Hadjikhani, Joseph, Snyder, & Tager-flusberg, 2006; McIntosh, Reichmann-Decker, Winkielman, & Wilbarger, 2006; Uddin, Iacoboni, Lange, & Keenan, 2007).

Studies have shown that there are individual differences in interpreting the expressions in others' faces (Neta et al., 2009). The present study showed that ASC traits are associated with facial expression processing, consistent with previous findings that high AQ scores are associated with poor facial expression processing (Baron-Cohen et al., 2001a). Importantly, exposure to the self-prime condition abolished the slower recognition time in the individuals with high AQ scores. These behavioral data are consistent with simulation deficit models of facial emotion processing in ASC (Dapretto et al., 2006; Hadjikhani, 2007; Hadjikhani et al., 2006; McIntosh et al., 2006; Williams, Whiten, & Singh, 2004; Williams, Whiten, Suddendorf, Perrett, 2001) in theory, although it is unclear from purely behavioral data why individuals with higher ASC-like traits are more responsive to self-face priming. Alternatively, it may be possible that individuals with poorer facial expression processing simply have a greater potential for improvement from the self prime intervention. The data from the current study suggest that discriminating facial expression is a malleable skill depending on the representations that are active during perception.

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*Figure 1.* Illustration of Experimental Procedure. Participants were randomly assigned to either the self or nonself experimental conditions. They generated facial expressions and were primed according to their assigned condition. They were then administered questionnaires and given the facial expression judgment task.

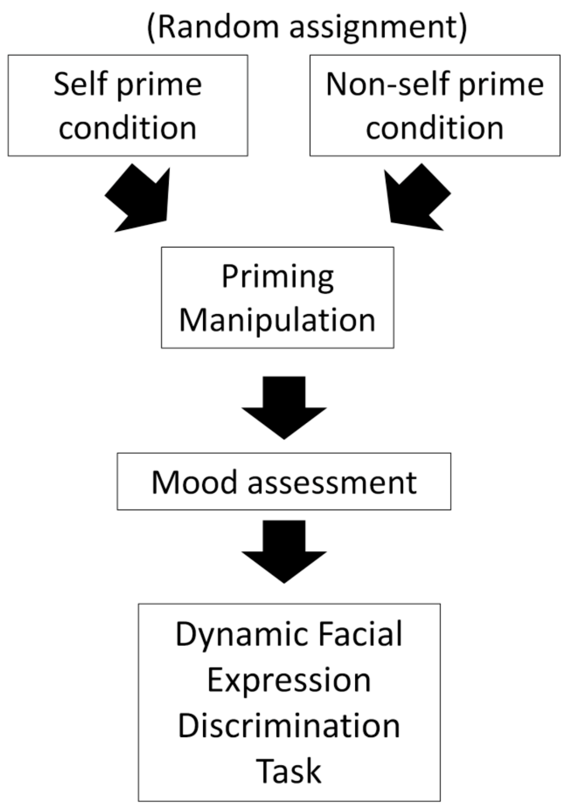

*Figure 2.* Activation with the Self-Face Prime Facilitates Facial Expression Processing. There was a significant main effect of Prime showing that the self prime group was significantly faster (that is, required less affective perceptual information) than the nonself group. There was also a significant main effect of Emotion Category showing that happy facial expressions were perceived earlier overall than angry facial expressions. The interaction was not significant. Error bars represent one standard error of the mean.

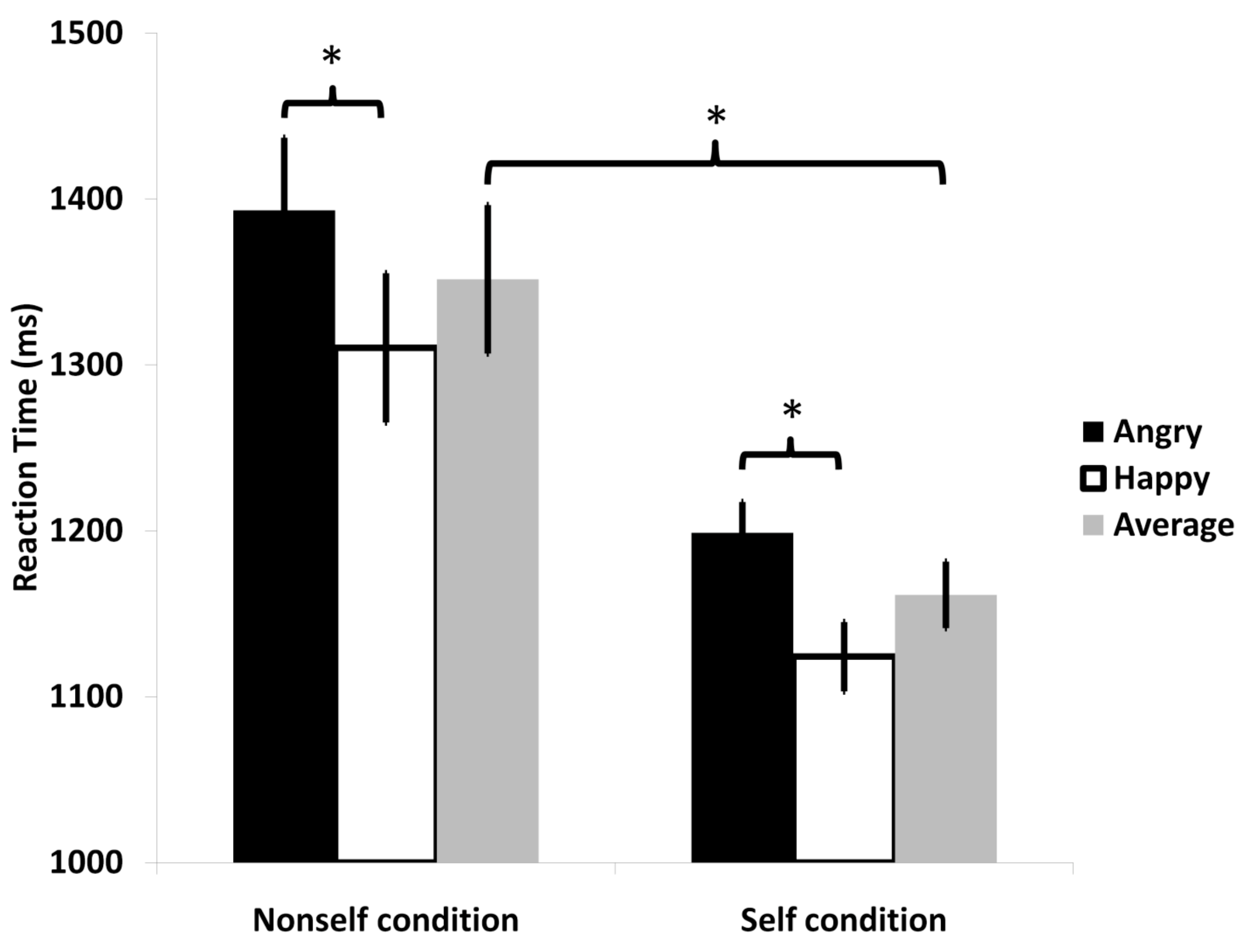

*Figure 3.* AQ Scores for the Self and Nonself Groups. The Autism Quotient scores of the nonself and self groups were not statistically different. Error bars represent one standard error of the mean.

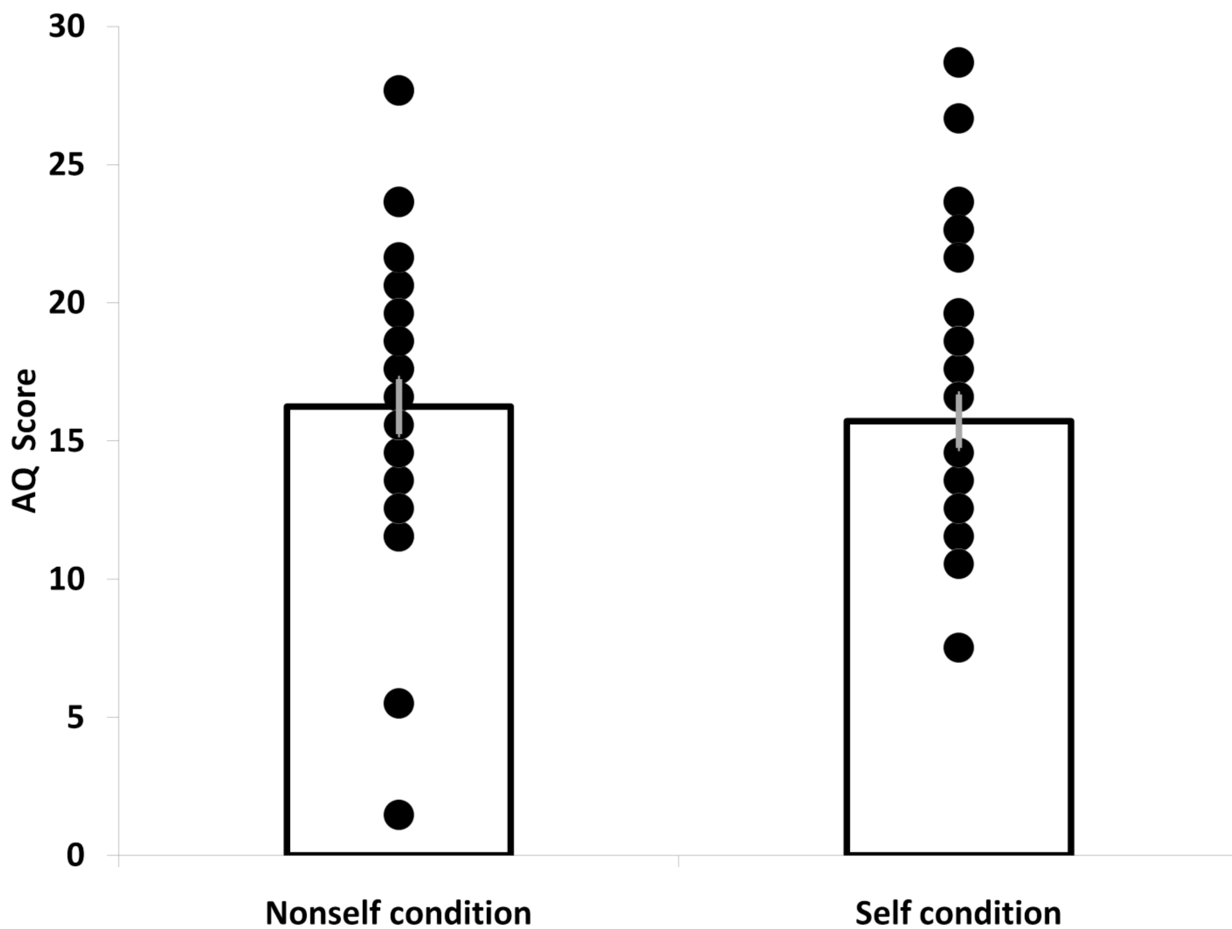

*Figure 4.* Activation of the Self-Face Prime Removes Association Between Autism Quotient (AQ) Score and Reaction Time. There was a significant interaction of Prime and AQ in the dynamic facial expression judgment task. For the nonself prime group, high AQ scores predicted significantly slower reaction time to recognize facial expressions (that is, high AQ scores were associated with needing more affective perceptual information to reach a correct decision). However there was no significant association between AQ score and reaction time for the self-prime group.