Goal-directed drinking behaviors can be modified through behavioral mimicry

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Abstract

Purpose: This study tested whether behavioral mimicry can alter drinking behavior. It was hypothesized that participants would increase drinking behaviors given increased confederate drinking, but not cup touching.

Methods: Nineteen healthy adults (M_{age} = 20.32 years) completed two picture description tasks; during one task a confederate frequently sipped water ('complete' drinking gesture) and during the other the confederate touched her cup, but did not drink ('partial' gesture). Outcome measures included: number of drinks/minute, number of cup touches/minute, percentage of time spent drinking, and percentage of time spent touching the cup.

Results: Participants spent more time drinking and had an increased drinking rate during the drinking condition versus the cup touching condition. For a majority of participants, drinking rate increased during the drinking condition versus baseline. Drinking, but not cup touching, rate also increased given increased confederate cup touching for many.

Conclusions: Mimicry likely contributes to social modeling of drinking behaviors. This effect appears more robust given a complete target gesture (full drink), however a partial goal-directed drinking gesture may also yield a mimicked response. Beyond the theoretical implications, these results provide directions for research investigating more naturalistic mechanisms for increasing dietary intake in various patient populations (e.g., individuals with dysphagia).

Introduction

Individuals with dysphagia often demonstrate decreased dietary intake and are at increased risk for malnutrition and dehydration (Finestone, Foley, Woodbury, & Greene-Finestone, 2001; Finestone, Greene-Finestone, Wilson, & Teasell, 1995; Foley, Martin, Salter, & Teasell, 2009; Leibovitz et al., 2007; McGrail & Kelchner, 2015; Serra-Prat et al., 2012; Whelan, 2001). The odds of being malnourished have been reported to be nearly 2.5 times higher among stroke patients with dysphagia as compared to patients with intact swallowing (Foley et al., 2009) and close to 20% of community-dwelling older adults with dysphagia were found to be malnourished or at-risk for malnourishment at a one-year follow-up (Serra-Prat et al., 2012). Further, up to 75% of long term care residents with dysphagia have been found to demonstrate multiple clinical markers of dehydration (Leibovitz et al., 2007), which is not surprising as patients with dysphagia, particularly those on oral intake alone and those on thickened liquids, are frequently found to not meet their daily fluid requirements (Finestone et al., 2001; McGrail & Kelchner, 2015; Murray, Miller, Doeltgen, & Scholten, 2014). These negative outcomes may be a result of the dysphagia itself or the dysphagia-related therapeutic interventions. In other words, individuals may limit or alter their food and liquid intake due to difficulty swallowing or fear of eating or choking (i.e., resulting from the dysphagia itself) or due to low palatability of texture-modified diets or low acceptability of swallow strategy recommendations (i.e., resulting from the therapeutic interventions).

The underlying medical cause of dysphagia and the concomitant impairments associated with that cause may further contribute to or exacerbate malnutrition and dehydration. For example, beyond swallowing impairment, risk factors for dehydration include decreased cognition, difficulty with communication, decreased sensation, and alterations in mobility (Murray, Doeltgen, Miller, & Scholten, 2015; Roque, Salva, & Vellas, 2013; Wotton, Crannitch, & Munt, 2008). Such a constellation of impairments is often seen in patients with dementia and following stroke – two populations that have a particularly high prevalence of dysphagia (i.e., greater than 50%) (Alagiakrishnan, Bhanji, & Kurian, 2013; Martino et al., 2005). Not surprisingly, individuals with dementia and following stroke also frequently demonstrate substandard nutritional intake (e.g., 50-80% of patients) (McGrail & Kelchner, 2015; Reed, Zimmerman, Sloane, Williams, & Boustani, 2005) and are at greater risk for malnutrition and dehydration (e.g., 45-50% of patients) (Murray et al., 2015; Roque et al., 2013), regardless of their functional swallowing status.

Malnutrition and dehydration are associated with decreased survival, function, and quality of life, increased frequency and length of hospital stays, higher rates of hospital readmission, healthcare associated infections, cognitive impairment, and depression, and higher healthcare costs (Barker, Gout, & Crowe, 2011; Sansevero, 1997). Conversely, good food and mealtimes are a sensory and psychological pleasure, instilling feelings of security, meaning, independence, and control, and ultimately improving health-related quality of life (Amarantos, Martinez, & Dwyer, 2001). Thus, the successful management of dysphagia for improved morbidity and mortality, particularly for those patients with dementia and following stroke who may be at greatest risk, requires careful consideration of nutritional intake along with improvements in swallow function.

Various strategies to improve intake, particularly for individuals with dementia and/or individuals with dysphagia, have been suggested, with mixed success (Abbott et al., 2013; Liu, Cheon, & Thomas, 2014; Vucea, Keller, & Ducak, 2014). Broadly, many of these interventions can be grouped within three categories: supplementation, environmental modifications, and staff/caregiver involvement. Of interest, while many of these interventions may warrant further investigation for meeting weight gain and nutritional intake goals, one recent systematic review and meta-analysis concluded that no particularly useful interventions were noted to improve hydration in people with dementia (Abdelhamid et al., 2016).

Nutritional supplements can be effective in reducing mortality and improving nutritional intake, body weight, and functional status (Liu et al., 2014; Nieuwenhuizen, Weenen, Rigby, & Hetherington, 2010). Unfortunately, these improvements in clinical outcomes are highly compliance-dependent. Oral supplements are less cost effective and appealing to patients as compared to real food (Abbott et al., 2013). Beyond being more susceptible to 'taste fatigue', such supplementation also isolates the nutritional component of eating from the sociocultural enjoyment involved in shared mealtimes (Abbott et al., 2013). Further, appropriate compliance and consumption of these supplements may rely on an already limited, and overburdened, staff. For example, it has been reported that staff may spend less than one minute per person encouraging consumption of supplements and meals (Nieuwenhuizen et al., 2010).

Multiple environmental modifications to promote mealtime success have been proposed, primarily for patients in the long-term care setting with or without dementia. Interventions studied are commonly multifaceted, manipulating, among other variables, the ambiance and atmosphere of the eating environment (e.g., temperatures, lighting, music, table settings), the methods of food service/selection (e.g., family/communal style meals, steam tables, increased resident choice), and the mealtime participants (e.g., eating in the company of others, eating with staff; see further details below). Such interventions have been found to lead to increased nutritional intake and nutritional status, extended meals, and improved quality of life (Abbott et al., 2013; Mathey, Vanneste, de Graaf, de Groot, & van Staveren, 2001; Nieuwenhuizen et al., 2010; Nijs, de Graaf, Kok, & van Staveren, 2006; Nijs, de Graaf, Siebelink, et al., 2006; Vucea et al., 2014). Conversely, one systematic review found that "environment/routine modification" interventions yielded low evidence for increased food intake (Liu et al., 2014). Further, such interventions are highly specific to the institutionalized setting – often striving to create an environment that is more 'home-like' – and therefore are not easily transferable to the various patient populations already living at home who continue to present with increased risk of dehydration and malnutrition.

A final intervention category suggested to improve nutrition and/or hydration involves staff/caregiver involvement and training, including providing one-to-one assistance and using verbal reminders. Targeted, one-to-one feeding assistance has been shown to improve nutritional intake for patients across multiple care settings (e.g., nursing home residents, hospitalized patients with dysphagia) and may lead to weight gain or maintenance (Abbott et al., 2013; Simmons et al., 2008; Vucea et al., 2014; Wright, Cotter, & Hickson, 2008). Such assistance can be successful when provided by either mealtime staff or trained, specialized volunteers (Green, Martin, Roberts, & Sayer, 2011; Vucea et al., 2014). However, some researchers have concluded that the evidence is insufficient regarding 'feeding assistance' as a tool for improving food intake, with a paucity of robust evidence (Green et al., 2011; Liu et al., 2014). Further, feeding assistance has a significant impact on staff time; staff time for one-to-one mealtime assistance has been estimated to take anywhere from 25 to 45 minutes per meal per patient compared to usual care that averages 5 to 10 minutes (Simmons et al., 2008; Simmons & Schnelle, 2004). Relatedly, retention of volunteers and staff for such programs can be difficult and volunteer skill can be very varied (Vucea et al., 2014).

Verbal prompts and positive reinforcement can improve eating and drinking independence (Abbott et al., 2013), with specific cues targeting self-feeding (e.g., verbal/tactile prompts, repeating instructions) promoting increased patient self-feeding (Van Ort & Phillips, 1995). However, such structured verbal cueing and systematic verbalizations have not been found to increase fluid intake, consistently increase food intake, or increase body weight (Beattie, Algase, & Song, 2004; Cleary, Hopper, & Van Soest, 2012; Van Ort & Phillips, 1995). These cueing paradigms also require one-to-one supervision. Together, increasing verbal reminders and providing one-to-one assistance are highly time intensive, may disrupt the natural flow of a mealtime, and may still result in substandard consumption (McGrail & Kelchner, 2015; Simmons, Osterweil, & Schnelle, 2001). Further, frequent reminders and conversations about health-related topics, such as those from significant others, may be construed by patients as controlling and threatening to their sense of autonomy (Goldsmith, Lindholm, & Bute, 2006). Relatedly, results related to the impact of dietary advice on increased nutritional intake and weight gain are extremely heterogenous (Baldwin & Weekes, 2011, 2012), suggesting that it may not be enough to simply tell patients to ‘eat/drink more’.

Ultimately, while various strategies have been suggested to improve intake, questions regarding their effectiveness and successful implementation exist, particularly when considering individuals with dysphagia outside of institutionalized settings. Many of these strategies specifically target increasing intake in nursing home and/or hospital settings, and require increased time, money, and effort in a climate of budget cuts and staffing shortages. Many of these strategies also 'medicalize' the mealtime, regarding meals as just another task that is needing to be completed, and shifting the focus away from the highly social role mealtimes serve in enhancing interpersonal involvement and fostering social connections. Finally, such strategies may place increased burden on caregivers, particularly informal caregivers in the home setting, further disrupting the social enjoyment of the mealtime process, the social relationship between the caregiver and the patient, and the patient's ultimate sense of autonomy.

Thus, it remains unknown whether less direct strategies that build naturally on the more social aspects of eating might be more appropriate for the maintenance, or enhancement, of nutritional intake during meals for individuals with dysphagia. This may be particularly important for individuals living outside of institutionalized settings, especially those with concomitant cognitive impairments (e.g., as related to dementia and/or stroke) that further increase the risk of malnutrition and dehydration. Social environment strongly influences eating behavior (Cruwys, Bevelander, & Hermans, 2015; Herman, 2015; Herman, Roth, & Polivy, 2003; Vartanian, Spanos, Herman, & Polivy, 2015). Food intake is impacted by the presence of others, with social companionship leading, depending on conditions, to either increased intake (augmenting effect) or decreased intake (inhibiting effect). This has previously been manipulated to a certain degree for individuals in residential care settings: having staff eat with residents has been shown to have some positive effects, promoting resident dignity and autonomy, quality of interactions and meal enjoyment, and weight gain (Charras & Fremontier, 2010; Ruigrok & Sheridan, 2006).

One social influence phenomenon likely underlying these findings is social modeling, or the adaptation of food intake to that of others (Cruwys et al., 2015; Vartanian et al., 2015). The effect is highly robust, with the modeling of food intake being documented among individuals of varying ages, in a variety of eating contexts, and regardless of hunger or satiety levels (Bevelander, Lichtwarck-Aschoff, Anschutz, Hermans, & Engels, 2013; Cruwys et al., 2015; Feeney, Polivy, Pliner, & Sullivan, 2011; Goldman, Herman, & Polivy, 1991; McFerran, Dahl, Fitzsimons, & Morales, 2009; Sharps et al., 2015; Vartanian et al., 2015). However, the underlying mechanism of this effect is unclear. Capitalizing on social modeling may lend to the development of new, more naturalistic, therapeutic targets for increasing nutritional intake in patient populations. Yet, it is first necessary to identify the underlying mechanism through which modeling occurs.

Behavioral mimicry, or the non-conscious imitation of others' behaviors, has been posited as a contributor to social modeling, supporting the automaticity of such modeling (Bevelander et al., 2013; Hermans et al., 2012; Koordeman, Kuntsche, Anschutz, van Baaren, & Engels, 2011; Larsen, Engels, Granic, & Overbeek, 2009; Sharps et al., 2015; van den Boer & Mars, 2015). Mimicry frequently occurs in human interaction, with interactants often mimicking the expressions, behaviors, speech, emotions, and goals of one another (see Chartrand & Lakin, 2013 for a review). Mimicry has been associated with feelings of affiliation, enhancing cohesion and rapport (Chartrand & Bargh, 1999; Chartrand & Lakin, 2013; Lakin & Chartrand, 2003). Engaging, albeit unconsciously, in mimicry contributes to the development of social relationships. Given the important psychosocial role that mealtimes play in daily life toward fostering social connections, mimicry may be increasingly likely during these shared meals. Thus, a link between mimicry and social modeling of intake is highly plausible.

Limited recent literature has explored the potential role of mimicry in social modeling of intake. Studies have shown that drinking behaviors of same-sex peers and movie actors influence young adults' alcohol consumption with participants being more likely to take a sip directly after observing someone else doing so (Koordeman et al., 2011; Larsen et al., 2009). Eating behaviors have been found to be similarly influenced, with both adults and children being likely to mimic their companions' food reaching and bite taking behaviors (Bevelander et al., 2013; Hermans et al., 2012; Sharps et al., 2015). However, questions related to the role of mimicry in social modeling remain unanswered.

First, it is unclear the degree to which mimicry underlies modeling as related to increasing *healthy* consumption, particularly drinking behaviors. In general, the literature base explicitly testing whether mimicry underlies social modeling in eating is limited, with only two studies looking beyond snack (high-energy-dense palatable foods) and alcohol consumption (Hermans et al., 2012; Sharps et al., 2015). Further, drinking behaviors remain largely absent in the mimicry literature, with two studies examining sip imitation in alcohol consumption (Koordeman et al., 2011; Larsen et al., 2009). Water consumption plays an essential role in the prevention of dehydration, a particular risk for individuals with dysphagia. Thus, the impact of social modeling, as being driven by mimicry, on water drinking behaviors warrants further investigation.

It is also unknown to what extent an eating-related gesture needs to be specific and 'complete' in order to trigger a mimicked response. Sharps and colleagues (2015) found a lack of evidence for non-specific mimicry; adolescents did not simply synchronize their general eating gestures or speed to match their parents, but rather timed the eating of specific food items to when their parents ate the *same* food item. This would suggest that behavioral mimicry in eating is particularly goal-directed. In another investigation of behavioral mimicry, Bevelander and colleagues (2013) recognized the important cue of reaching for and picking up food during consumption and coded for ‘food picking’ behaviors. However, the food item was always eaten. It is not known whether the reaching/picking gesture alone would have triggered similar findings. Further, these studies investigated eating behaviors of children and adolescents. Prior to being able to translate mimicry-related laboratory findings into clinically relevant therapeutic strategies, it is necessary to better characterize the quality (i.e., specificity and completeness) of the gesture needed across adult populations.

The purpose of the current preliminary study was to explicitly test whether healthy drinking behavior can be altered as a result of behavioral mimicry, providing initial proof of principle for the manipulation of this phenomenon toward developing therapeutic interventions aimed at increasing nutritional intake in individuals with dysphagia. Participants completed two picture description tasks with a research assistant posing as another participant (confederate); during one task the confederate frequently took sips of water (‘complete’ drinking gesture) and during the other the confederate touched her cup of water, but did not drink (‘partial’ drinking gesture). Unrestricted access to water was provided. Based on previous studies of mimicry in food and alcohol consumption (Bevelander et al., 2013; Hermans et al., 2012; Koordeman et al., 2011; Larsen et al., 2009; Sharps et al., 2015), we hypothesized that participants would increase their water drinking behaviors in the presence of increased drinking, but not cup touching, by the confederate.

Methods

Participants

Twenty undergraduate students were recruited. Inclusion criteria, primarily as related to the cover study (see details below), included normal or corrected vision and hearing, being an English speaker, and no previous history of speech or language difficulties. Data from one participant was excluded from subsequent analyses as he refused water in favor of juice. The final sample consisted of 19 young adults (M_{age} = 20.32 years, SD = 1.80; 13 females). The Institutional Review Board at the University of Oregon approved the study. All participants signed written informed consent prior to participation.

Task procedures

The protocol was adapted from the methodology of Chartrand and Bargh (1999). Participants were videotaped interacting with a young-adult female confederate posing as a second participant during two image description tasks (the 'cover study'). Prior to the arrival of the confederate, participants were offered a cup of water given the high speaking demands of the tasks. To ensure that the cups would remain accessible and in line of sight throughout the study, tape was used to indicate a designated 'cup-holding spot' on the table. Participants were informed that this was to allow for optimal videotaping of their nonverbal behaviors. At some point after providing the participant with the glass of water, the researcher left the room to see whether the confederate (playing the role of the second participant) was having difficulty finding the location of the study.

In order to explicitly test the role of mimicry in social modeling, or the completely *unconscious* and *unprompted* imitation of behavior, it was necessary to place drinking within a task that was not directly related to eating or drinking. Thus, participants were recruited to take part in a cover study examining the effects of different types of visual stimuli on conversational output. The cover study involved two image description tasks, during which the participant and confederate took turns describing series of images in two 15-minute sessions while seated next to each other. In one task, ten images of paintings were presented and in the other, ten images of photographs were presented. Task order was randomly assigned with some dyads describing the paintings first and others describing the photographs first. Two confederate behaviors were manipulated in the sessions: cup/water drinking (complete drinking gesture) and cup touching (partial drinking gesture). Order of confederate behavior was also randomly assigned resulting in the confederate sometimes drinking during the painting description task and sometimes drinking during the photograph description task. There was no difference in duration between the drinking (M = 14.82 minutes, SD = 3.07) and touching conditions (M = 14.79 minutes, SD = 2.90; $t(18) = .036$, $p = .972$). Following both picture description tasks, a funneled debriefing occurred (see Chartrand & Bargh, 1999), in which participants first filled out a questionnaire regarding the quality of the interaction, rapport felt with the partner, and cohesion of the task stimuli to probe for any suspicion regarding the true nature of the study and conscious awareness of any specific mannerisms (i.e., cup drinking or touching) the confederate displayed. Participants were then debriefed. No participants indicated any suspicion regarding the true nature of the study or awareness of confederate mannerisms related to the cup.

Data collection and analysis

While completing the tasks, the confederate and participants were videotaped using two separate Cannon VIXIA HF R52 camcorders. Separate camcorders were used for the confederate and participants to ensure that coders of the participant videos were blind to condition and that the movements of the confederate would not influence the coding. Across the entire videotaped recording, the occurrence and duration of each drink and cup touch was coded for both the participant and the confederate. The videos were then segmented into three conditions: baseline (from the time the cup of water was presented until the confederate entered the room; researcher may be present), confederate drinking (termed 'drinking condition', regardless of picture task condition), and confederate cup touching (termed 'cup touching condition', regardless of picture task condition).

For each condition, four primary participant outcome measures (the dependent variables) were calculated: number of drinks per minute, number of cup touches per minute, percentage of time spent drinking, and percentage of time spent touching the cup. Number of drinks and cup touches per minute for the confederate was also calculated for a manipulation check. Repeated-measures ANOVAs were used to test the effects of condition (i.e., drinking versus cup touching) on the dependent variables, using baseline measures as the covariate. Paired t-tests were used to quantify differences in mean drinking behavior between the task conditions and baseline. A p-value of $< .05$ was considered statistically significant. Statistical analysis was performed using SPSS (IBM Corporation, Armonk, NY).

Results

Manipulation check

In order to ensure that the confederate was able to consistently perform the target behaviors in the target session more than in the non-target session, the number of times per minute she spent drinking and touching the cup for both conditions was coded. A repeated-measures ANOVA revealed that the confederate spent more time drinking during the drinking condition (M = 1.34 drinks/min, SD = 0.42) as compared to the cup touching condition (M = 0.01 drinks/min, SD = .03; $F(1,18)$ = 183.88, p < .001). Similarly, the confederate spent more time touching the cup during the cup touching condition (M = 5.49 touches/min, SD = 3.35) as compared to the drinking condition (M = 0.19 touches/min, SD = .43; $F(1,18)$ = 45.68, p < .001).

Drinking behaviors

Figure 1 illustrates the number of drinks per minute at baseline plotted against the number of drinks per minute during the two experimental conditions for each participant. Overall, 12 participants drank more during the drinking condition and 9 participants drank more during the cup touching condition as compared to baseline, while 6 participants drank less during both experimental conditions as compared to baseline (see Figure 1a). Of note, the 6 participants that drank less during the task conditions had much higher rates of baseline drinking than the remaining participants, with 2 participants having baseline drinking rates greater than one SD above the group's mean (M = 0.27 drinks/min, SD = .53). The data points for these two participants are removed in Figure 1b (but remain included in subsequent analyses). Despite the majority of participants increasing their drinking rate during the drinking condition, no statistically significant difference was found as compared to baseline ($t(18)$ = .441, *p* = .332). Similarly, no statistically significant difference was found in drinking rate during the cup touching condition as compared to baseline (*t*(18) = 1.228, *p* = .118).

While no increase in drinking rate in either task condition was found overall as compared to baseline, further comparisons of drinking behavior between the two task conditions were made to determine whether the presence of actual drinking, rather than just a drinking-related gesture, would increase the likelihood of a drinking response. Given the variability in baseline drinking behavior between participants, these values were used as covariates in the analyses in order to adjust for these individual differences. Participants drank more frequently during the drinking condition (*M* = 0.22 drinks/min, *SD* = .21) as compared to the cup touching condition (*M* = 0.13 drinks/min, *SD* = .15; *F*(1,17) = 9.738, *p* = .006; see Figure 2). Participants also spent more task time drinking during the drinking condition (*M* = 1.95%, *SD* = 1.87) as compared to the cup touching condition (*M* = 1.09%, *SD* = 1.29; *F*(1,17) = 5.625, *p* = .030; see Figure 3). In other words, participants were more likely to drink (i.e., drank more frequently and spent more time drinking) when the confederate was also drinking as compared to when the confederate was touching her cup.

Cup touching behaviors

To further explore the specificity of behavioral mimicry, participant cup touches were also analyzed. As no participants touched their cup without drinking during the baseline period, no covariates were used in the analyses. Overall, cup touching occurred very infrequently (see Figures 2 and 3). There was no difference in the frequency of participant cup touches between the drinking (*M* = 0.03 touches/min, *SD* = 0.07) and cup touching conditions (*M* = 0.04 touches/min, *SD* = 0.10; *F*(1,18) = 0.019, *p* = .892; see Figure 2). Similarly, there was no difference in the percentage of task time that participants spent touching the cup between the drinking (*M* = 0.45%, *SD* = 1.14) and cup touching conditions (*M* = 0.33%, *SD* = 1.11; $F(1,18) = 0.112$, $p = .741$; see Figure 3). That is, participants were not more likely to touch their cup (i.e., frequency or duration) when the confederate touched her cup as compared to when she drank from her cup.

Discussion

This study aimed to preliminarily investigate whether healthy drinking behavior can be altered as a result of behavioral mimicry, providing initial proof of principle as to whether mimicry could provide a potentially useful strategy for targeting dietary consumption among individuals with dysphagia. In line with our hypothesis, participants mimicked healthy drinking behaviors during social interaction in the context of increased confederate water drinking. Overall, participants spent a greater amount of time drinking and had an increased drinking rate during the drinking condition as compared to the cup touching condition. Further, the rate of drinking increased during the drinking condition as compared to baseline for the majority of participants. Thus, the current results support that mimicry likely contributes, at least partially, to social modeling for healthy drinking behaviors, similar to the findings for other eating- and drinking-related behaviors (Bevelander et al., 2013; Hermans et al., 2012; Koordeman et al., 2011; Larsen et al., 2009; Sharps et al., 2015). Further, as the complete drinking gesture facilitated an increased drinking rate as compared to the partial drinking gesture (i.e., cup touching), these findings also suggest a potentially necessary level of specificity and completeness in a target gesture for mimicry to occur.

Yet, while not as frequent, confederate cup touching did increase drinking rate for many participants. This is in stark contrast to the lack of an increase in participant cup touching behavior during the cup touching condition. That is, while cup touching prompted increased drinking for some participants, the isolated gesture itself was not mimicked. It is possible that cup touching was unconsciously 'viewed' by the participants as a partial drinking gesture, as was intended, rather than a non-goal-directed isolated gesture. Viewing the cup touching gesture in a holistic manner, and as a function of context, is in line with previous literature and can help explain its role as a potential trigger for increased cup drinking. Eating is a complex process that involves a variety of thoughts, intents, actions, and sensations prior to swallowing and ingestion (Leopold & Kagel, 1983, 1997; Maeda et al., 2004). These 'pre-oral', or more preparatory, components of the process influence later movement responses (Besier, Lloyd, Ackland, & Cochrane, 2001; Johansson & Westling, 1988; Shune, Moon, & Goodman, 2016) Given the high frequency of eating and drinking behaviors in daily life, it is then highly plausible that the interpretation of a cup touch as an isolated event would be rejected in favor of interpreting the cup touch as a preparatory drinking action.

This link between preparatory and actual action is further supported by research on ingestive mirror neurons, which have found to activate in response to observations of both preparatory (e.g., picking food) and actual eating behaviors (Ferrari, Gallese, Rizzolatti, & Fogassi, 2003; Fogassi et al., 2005; Rizzolatti & Craighero, 2004). In other words, recognizing and understanding an action's intention (e.g., touching/grasping a cup to drink) activates the same set of neurons that are activated during execution of the intended action (Fogassi et al., 2005). It is important to note, however, that the cup touching condition yielded significantly less drinking (lower rate and less time spent) as compared to the drinking condition. Whether this reflects a necessary level of specificity and gesture completeness to facilitate mimicry, as previously suggested, or was a product of the gesture selected (e.g., cup touching may be less noticeable that picking a cup up, but not drinking) remains to be seen. Taken together, these current findings and the previous literature indicate that it will be valuable to continue to investigate the role of gesture quality (i.e., specificity and completeness) in behavioral mimicry.

Despite individual differences observed between baseline drinking behaviors and drinking during the tasks, overall no statistically significant difference was found in drinking rate during the tasks as compared to baseline. This may be reflective of differences in condition length, one limitation of the current study. While the length of the drinking and touching condition segments were closely monitored, the length of the baseline segment was not controlled. As noted, a few participants had much higher rates of drinking at baseline; many of these participants also had short baseline segment durations. It is possible that for these participants, their baseline drinking rates were artificially driven up given the short segment duration, which ultimately negated overall group differences.

It is also possible that the nature of the cover task influenced drinking behaviors during the conditions. Young adults tend to be particularly task driven, with behavior often being driven by goals related to the obtainment of novel information/experience (Carstensen, 1992; Carstensen, Fung, & Charles, 2003). This is especially true when potential goals compete. Thus, it is possible that for the participants in the current study the goal of task completion (i.e., describing the pictures) partially overrode the goals related to mimicked drinking behaviors. Comments the participants made during debriefing highlighted this as a possibility. Many participants commented that while they did, at times, think about taking a sip, they did not want to disrupt the flow of the tasks or the conversation. This could also further explain the lower occurrence of drinking behavior overall. To further investigate the usefulness of mimicry in promoting increased water intake, particularly for younger adults, it would be beneficial to utilize a more naturalistic eating environment in which the goals of the task are more aligned with eating-related goals.

Another limitation of the current study is that quantity of water consumption was not assessed. Although participants had an increased drinking rate and spent more time drinking during the drinking condition, the total amount of water consumed during the conditions was not measured. The ability to alter not only drinking rate, but also quantity of consumption, would certainly increase the robustness of the impact of mimicry on eating/drinking behavior and warrants further investigation.

Further, it is important to recognize that the extension of these preliminary positive findings among healthy younger adults to older adults, particularly clinical populations of older adults (i.e., with dysphagia, dementia, and/or following stroke) should be done with caution. Very little is known about social modeling and mimicry in eating among older adults. As compared to younger adults, older adults have a heightened awareness of current feeling-states, prompting them to structure their social worlds to optimize emotionally meaningful experiences (Carstensen, 1992; Carstensen et al., 2003). As mimicry enhances social interactions and the development of relationships, engaging in mimicry likely serves an increasingly important role in the interactions of older adults. Thus, it is possible that mimicry will have a more influential role in social modeling for these individuals. However, this remains unknown. Further, the impact of swallowing impairment and other functional limitations associated with dementia and stroke on an individual's susceptibility to mimicry during mealtimes has not been studied. Thus, in order to substantiate the clinical utility of mimicry in enhancing nutritional intake, it is important for future research to determine 1) the robustness of mimicry's impact on healthy consumption in older adults, and 2) whether (and how) mimicry impacts consumption in clinical populations. The influence of mimicry on consumption in younger adults as suggested here supports continued investigations of mimicry's facilitating effect in these more vulnerable populations.

Conclusion

This study suggests that behavioral mimicry may contribute to the social modeling of healthy drinking behaviors, particularly for those individuals who demonstrate low(er) baseline levels of consumption. This effect is more robust given a target gesture that is complete and specific (i.e., full drink), however it appears plausible that a partial goal-directed drinking gesture (i.e., touching a cup) may also yield a mimicked response. These findings provide useful directions for future research investigating mechanisms for increased (water) intake across various clinical populations, which ultimately can promote the action of 'eating together' to facilitate both improved nutrition and psychosocial well-being.

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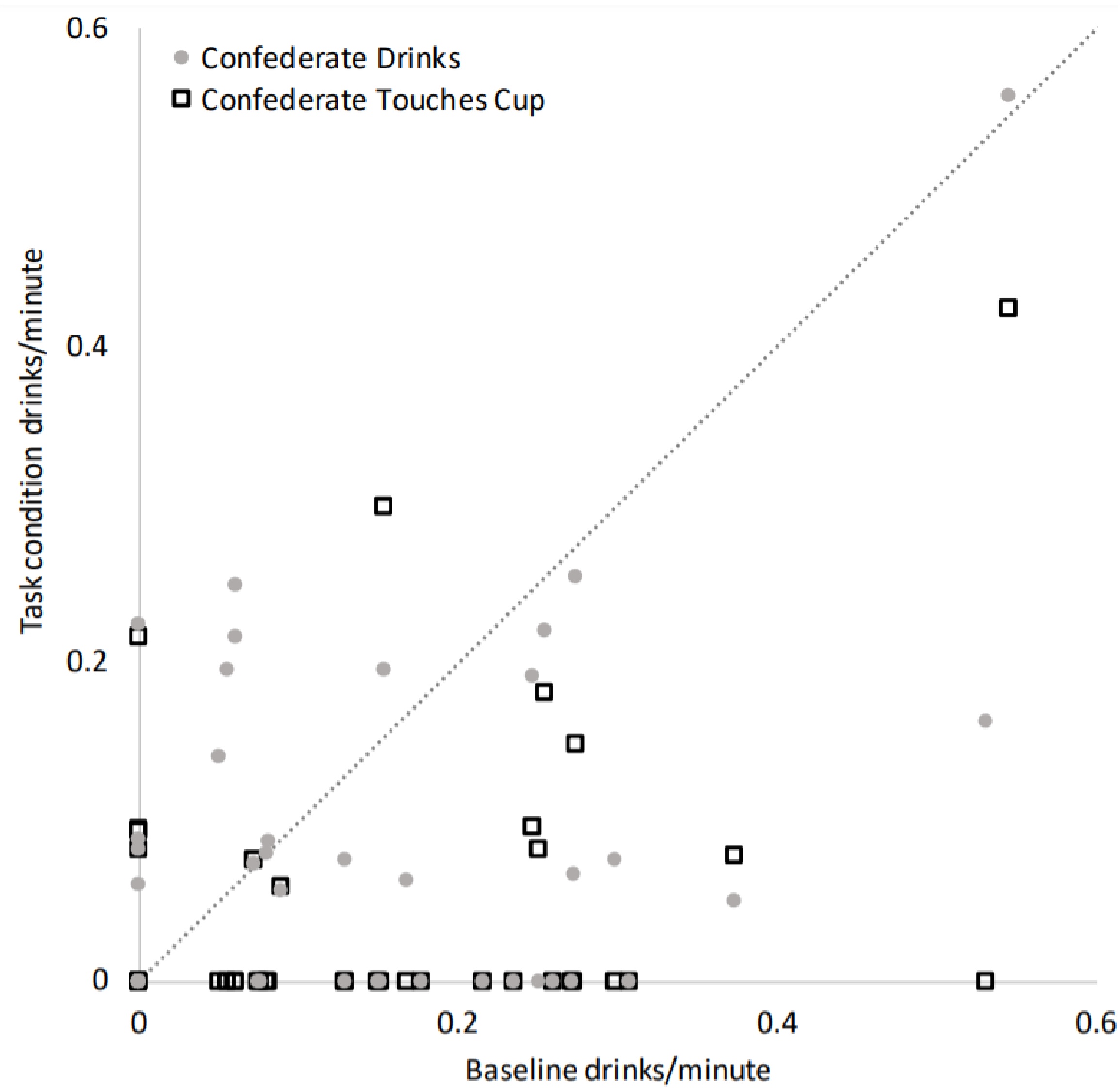

Figure 1. Participant drinks per minute for each condition (baseline, confederate drinking, confederate cup touching) plotted for all participants (1a) and excluding two participant outliers (1b; boxed region in graph 1a). Data points falling above the dotted reference line indicate a higher consumption rate during the task condition as compared to baseline (*n* = 12 drinking condition, *n* = 9 touching condition), points falling below the reference line indicate a lower consumption rate during the task as compared to baseline (*n* = 6 drinking condition, *n* = 6 touching condition), and points on the reference line indicate the same consumption rate (*n* = 1 drinking condition, *n* = 4 touching condition).

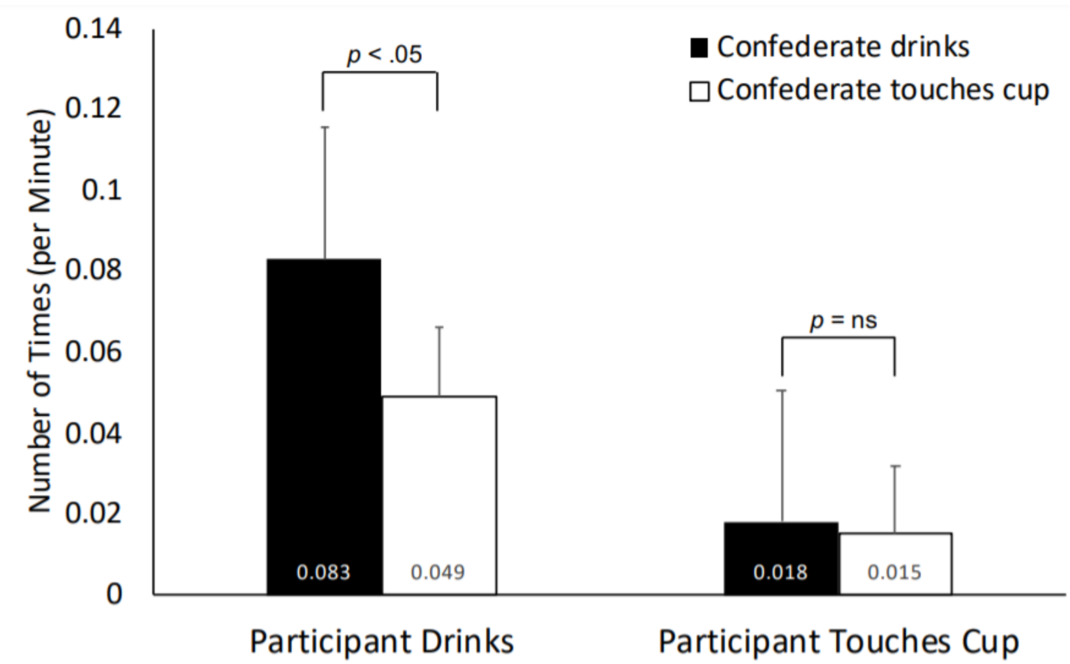

Figure 2. Number of times participants drank and touched their cup per minute for the two task conditions.

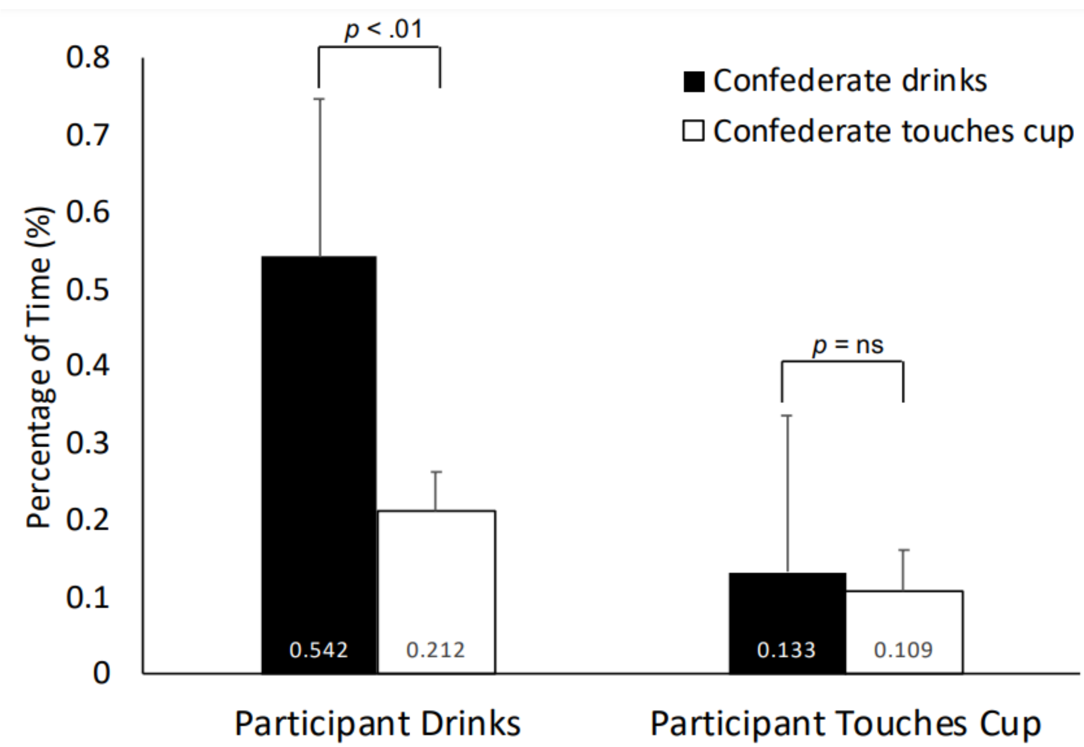

Figure 3. Percentage of task time participants spent drinking and touching their cup for the two task conditions.

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