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Intensity of Meaning upon the Efficiency of a Reach Movement in Healthy Adults using
Negatively Associated Objects

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Abstract

The objective of this study was to determine whether reaching for negatively preferred objects elicited a different quality of reach movement compared to neutrally preferred objects. Forty healthy adults were asked to reach for seven different types of candy while wearing sensors on bony landmarks of their dominant upper extremities including the ulnar styloid process and metacarpophalangeal joint of the third digit. Motion analysis technology was used to capture kinetic and kinematic data from these sensors, in particular, movement time, movement units, peak velocity, displacement, and percentage of movement time to peak velocity were measured. After reaching for each candy, participants filled out a corresponding 26 item preference survey designed to gather information about their preference for that particular candy. The candies ranged from Hershey's[®] Milk Chocolate to Hotlix[®] Insect Candy in order to represent a variety of preferences. Items were rated on a 5 point Likert scale that ranged from "Strongly Agree" to "Strongly Disagree." The results indicated that the quality of participants' reach movements were less efficient when reaching for their least preferred compared to their neutrally preferred candies on the variables of movement time, movement units, and peak velocity, but not for displacement and percentage of movement time to peak velocity. These findings are congruent with previous studies that have investigated occupational performance during situations involving relative risk, and contribute to the growing body of knowledge that exists regarding occupational performance during negatively associated occupational forms. Therapists can use this knowledge to synthesize occupational forms where a less efficient quality of reach may be desirable for example during safety interventions, in order to help clients develop situationally appropriate skills.

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Meaning is a multidimensional concept of great importance to the profession of occupational therapy. When a person ascribes meaning to an occupation, it can lead to enhanced occupational performance. This is a fundamental assumption within the profession of occupational therapy and has been corroborated by numerous research findings (Kircher, 1984; Henry, Nelson, & Duncombe, 1984; Sietsma, Nelson, Mulder, Scheidel, & White, 1993; Wu, Trombly, & Lin, 1994; Murphy, Trombly, Tickle-Degnen, & Jacobs, 1999; Hartman, Kopp Miller, & Nelson, 2000; Holubar & Rice, 2006; Rice, Davies, & Maitra, 2009; Rice & Renock 2006). The findings of these studies have direct implications for occupational therapy practice, where it is the desire of the therapist and the client, for the client to be successful at a variety of occupations. But what is meaning? And how does one ascribe it? How intense does the level of meaning have to be to in order to elicit a greater occupational performance?

In their Conceptual Framework for Therapeutic Occupation (CFTO), Nelson and Thomas (2003) describe meaning as the interpretation one makes out of the occupational form, (or context). Meaning is a subjective experience which cannot be directly accessed or manipulated by others. The occupational form on the other hand, is external to the person and may be altered by outsiders. How a client ascribes meaning is dependent on the interaction between his or her developmental structure, (or unique qualities), and the physical and sociocultural aspects of the occupational form. Due to these variations, individuals may ascribe different meanings to the same occupational form (Nelson & Thomas, 2003).

Although one can never fully predict what kind of meaning a person will assign to an occupational form, it is the objective of the occupational therapist to synthesize the occupational

form based on his or her knowledge of the client's developmental structure. This is done in the hope that meaning will occur, and the client will experience what Nelson and Thomas (2003) describe as purpose, or a desire to act. This desire usually results in active doing by the client, also called occupational performance (Nelson & Thomas, 2003).

Even though meaning is a subjective experience, the resulting occupational performance (in a particular occupational form) may be similar among groups of individuals who share something in common (e.g. college students, healthy adults, persons with CVA or TBI). This has made it possible for various occupational forms to be systematically studied in order to distinguish which ones lead to greater occupational performance. Occupational forms that have been examined under this premise include occupationally embedded exercise (also known as purposeful or materials-based activity) versus rote exercise, preference, choice versus no choice, hands-on learning versus demonstration, keeping versus not keeping, immediate versus prolonged exposure, and contextual relevance and ownership.

Kircher (1984) studied the effect of purposeful versus non-purposeful occupation amongst twenty-six healthy adult females using a counterbalanced design. Purposeful occupation was operationalized as jumping with a rope, and non-purposeful occupation as jumping in place. Each participant was attached to an EKG during the experiment. Using The Borg Scale of the Rate of Perceived Exertion (RPE), participants were asked to stop jumping once they felt they were working very hard (a level 17 on the scale). Results indicated that participants' heart rates at a predetermined RPE were significantly higher when jumping with a rope than jumping without one. In other words, when engaged in purposeful occupation compared to non-purposeful occupation, a higher heart rate was able to be obtained before the

participants felt like they were working very hard. This study was the first to measure the benefits of purposeful occupation (or occupationally embedded exercise) in this way.

Henry et al. (1984) examined the effect of choice versus no choice during an individual or group origami activity with forty female college students. Choice was operationalized as the participants being able to choose which origami designs they used. Results showed that participants who had no choice, and were in a group situation viewed themselves as less powerful compared to participants in a group situation who had a choice.

Sietsma et al. (1993) investigated the effects of occupationally embedded exercise versus rote exercise on the range of motion of twenty adult men and woman with traumatic brain injury. Participants in the occupationally embedded condition were asked to lean forward and reach in order to play a game, whereas those in the rote condition were only asked to lean forward and reach. The results revealed that range of motion was greater in the occupationally embedded condition. These findings are useful because they suggest that populations with disabilities can benefit from added meaning to the occupational form.

Wu et al. (1994) explored the effects of materials based occupation versus imagery based and rote occupation from a kinematic perspective amongst thirty-seven female college students. Participants in the materials based condition we asked to pick up a pencil from a pencil holder and prepare to write their name, participants in the imagery based condition were asked to imagine picking up a pencil, and those in the rote condition were asked to reach forward. The results indicated that materials based occupation leads to faster, smoother movement than imagery based or rote occupation.

Murphy et al. (1999) studied the effect of keeping versus not keeping an end-product, on intrinsic motivation. Fifty female college students chose between painting a ceramic vase,

decorating cookies, stringing beads to make a necklace, or creating stationary. Participants were told in advance whether they would be keeping or not-keeping the end products. Results showed that participants engaged in their occupation of choice longer when they knew they could keep the end product.

Hartman et al. (2000) investigated the effects of hands-on occupation versus demonstration on recall memory in children. Seventy three third grade boys and girls either watched a model volcano being made (demonstration condition) or participated in making a model volcano (hands-on learning condition). Following each condition the participants were asked to recall the steps required to make the volcano. The researchers found that participants in the hands-on condition recalled more steps than those in the demonstration condition.

Holubar and Rice (2006) studied the effects of context (familiar or unfamiliar) and ownership (object owned by the participant or owned by the researcher) on quality of movement during a reaching and placing task involving thirty-two adult women. The familiar context was the participant's home and the unfamiliar context was the research laboratory. The object was a mug that was either owned by the participant or the researcher. The results indicated that participants' movements were more efficient (indicated by less movement time) when reaching for their own mug regardless of the context. Movement units were also fewer when participants reached for their own mug in the lab setting compared to at home. No significant differences were found on the factor of context.

Rice et al. (2009) explored the effects of exposure (prolonged or immediate) and object relevancy (a cup or a mass of clay) on quality of movement during a reaching and placing task involving fifty-nine adult female volunteers. The results indicated that prolonged exposure to the

cup or clay led to more efficient movement than immediate exposure, as indicated by less movement time and fewer movement units. No difference in performance was found between reaching for the cup versus the clay, however, in the prolonged exposure condition peak velocity occurred later and the average velocity was reduced when reaching for the clay versus the cup.

Rice and Renock (2006) examined the effects of preference on quality of reach amongst forty-three healthy adult females. Participants ranked magazines from most to least preferred and were then asked to reach for the middle of three magazines from a 'line up' that contained their most preferred, least preferred, and neutrally preferred choices. The results were that the quality of movement was less efficient when reaching for a neutrally preferred magazine in comparison to a least preferred magazine as indicated by a greater movement time and more movement units. No differences in quality of movement were found between reaching for one's most and least preferred magazines.

The overarching theme of the studies mentioned above is that they use contrasting occupational forms with the intention that certain conditions will elicit greater meaning (and therefore better occupational performance) than others. The range of occupational forms used, and the variety of dependent variables measured across these studies suggests the pervasiveness of meaning to enhance occupational performance in many ways. Generally, the studies mentioned above support this idea; however, the majority of occupational forms were chosen by the researchers. Perhaps these preselected occupational forms did not elicit enough of, or the sort of meaning the researchers expected for every participant. This may explain why some participants performed better in the condition that was predicted to be less meaningful.

Besides the Rice and Renock (2006) study, participants' preferences for the occupational forms presented to them were not taken into account. Rice and Renock (2006) directly measured

preference for a variety of magazines by asking participants to rate them on a 1-10 scale, before engaging in a reaching task. It can be assumed that liking or not liking something can affect the intensity of meaning one feels towards an object or situation. A particular preference for an occupational form can therefore affect one's occupational performance. Further investigation is needed to examine the role of preference on meaning and occupational performance. If many of the studies above assumed a greater liking for a particular occupational form, can just as strong a disliking for an occupational form also affect occupational performance? The disliking of an occupational form could occur for a number of reasons, for example level of perceived risk, fear, and disgust. Perhaps these negatively associated situations could also contribute to one's meanings and subsequent occupational performance. Interestingly, Rice and Renock (2006) found no differences in the efficiency of participants' movements when reaching for magazines they liked the most (positive association) and those they liked the least (negative association).

The following studies of perceived risk point towards a relationship between negatively associated situations and occupational performance: Rice and Thomas (2000) had fifty-six healthy adult men and women reach for and pour a pitcher of hot and cold water to see if the difference in temperature would elicit different patterns of movement. It was found that movement time, displacement, and movement units were significantly greater during the hot water condition than during the cold water condition. The hot water condition had a greater level of risk associated with it because of the possibility of harm. The results indicate that the level of perceived risk in an occupational form can affect occupational performance. This has practical implications for occupational therapy because therapists can use perceived risk to grade occupational forms up or down. This will allow the patient to learn to adjust their occupational

performance appropriately according to different situations they may come across in everyday life that potentially involve risk.

In a replication of the above study, Thomas and Rice (2002) asked fifty male and female well-elderly individuals to reach for and pour hot and cold water. The results showed that elderly individuals use different movement dynamics when pouring hot water compared to cold water. This was evidenced by a greater movement time, a greater displacement time, more movement units, and a smaller percentage of movement time to peak velocity during the hot water condition.

Perceived risk was also studied by Fuller, Thomas, and Rice (2006) with twenty-eight males and females with cerebrovascular accident. Participants were asked to transfer either raw (high risk condition) or plastic eggs (low risk condition) from an egg carton into a bowl with other eggs. All participants took part in both conditions using their affected and non-affected upper extremities. Movement time was greater for the affected arm in both the high and the low risk conditions. The higher risk condition also elicited a greater movement time regardless of whether the affected or unaffected limb was used.

These studies provide preliminary evidence that occupational forms with negative associations may impact a person's occupational performance. Further research into this topic would be beneficial to gain a deeper understanding of this phenomenon.

The first purpose of this study is to explore the idea that meaning can be generated during both positively and negatively associated situations. Traditionally, prior research has focused on the positive end of the continuum. More recently, literature has begun exploring the negative end through studies of relative risk. This study will combine these approaches, thus adding to

the body of knowledge that exists about the relationship between meaning and occupational performance.

The second purpose of this study is to build on prior research into participant preference. In the majority of prior research, participant preference for the experimental condition was assumed. Participants in this study will be asked to rate how much they like or dislike a given occupational form. By measuring a participant's preference, important information can be gathered about how both ends of the positive/ negative continuum affect a person's intensity of meaning.

Candy will be the occupational form used in this study. Hypotheses are as follows:

- 1) There will be a difference in the kinematics and kinetics used by participants when reaching for a variety of different candy.
- 2) There will be a difference in the kinematics and kinetics used by participants when reaching for a variety of different candy based on the intensity of how much they like/ dislike the candy, specifically, the greater the "dislikeness" the lesser the movement efficiency.

Method

Participants

A sample of convenience was used to recruit participants from the mid-west portion of the United States. Participants ($n = 40$) were healthy adult men and women ages 18 to 51 years ($M = 25.5$ years, $SD = 5.6$ years) and consisted of college students, faculty members, and community members of either hand dominance. Recruitment strategies involved word of mouth, e-mail, and flyers posted on local bulletin boards. Originally, an $n = 77$ was planned. This sample size was based on a power analysis using the standard deviations for movement time

from Rice and Renock (2006). Specifically, using a standard deviation of .72 and assuming alpha to be .05, and beta to be .80, we expected to find a significant difference in movement time, with a similar movement time difference to that found by Rice and Renock (2006).

Exclusion criteria were any orthopedic or neurological impairment that would adversely affect performance in the task, and/ or peanut allergies.

Instrumentation

Prior to this study, a pilot survey was conducted to gather a variety of opinions about preferences for different types of candy. The survey consisted of a 26 question Likert-type scale developed specifically for this study. Questions were designed to estimate the intensity of meaning associated with seven types of candy. Nine occupational therapy and physical therapy students and faculty at the University of Toledo took part in the pilot survey. Faculty members served as a panel, providing expert opinion about the survey design. A measure of kurtosis of the survey results revealed a good dispersion of preferences for the different types of candy among the participants. Internal consistency using Cronbach's coefficient alpha (α) (Cronbach, 1951), was found to be between .86 and .954. In general, a coefficient that approaches .90 is indicative of high internal validity (Kielhofner, 2006). This suggests that the level of agreement between question items for each of the seven types of candy was high.

Apparatus

Three dimensional kinematic and kinetic data were collected at 100 Hz using Qualysis Track Manager Version 2.3 integrated with four ProReflex cameras. The system recorded the x, y, and z-positional coordinates of reflective makers attached to bony landmarks on the participants' dominant upper extremities.

Dependent Variables

Based on the results and feedback gathered from the pilot survey, intensity of meaning was measured on a 26 question Likert-type scale (see Appendix). The types of candy that were used in this study were Hershey's[®] Milk Chocolate, Hershey's[®] Special Dark, PayDay[®], Milk Chocolate Reese's[®], Hotlix[®] Insect Candy, Hershey's[®] Cookies 'n' Crème, and Twizzlers[®] Black Licorice. Each question associated with the candy had five potential responses including strongly agree, agree, neutral, disagree, and strongly disagree. For positively worded statements, a response of strongly agree indicated a highly positive intensity of meaning whereas for negatively worded statements, a response of strongly agree indicated a highly negative intensity of meaning. These responses were coded using a numerical system and converted into intensity of meaning scores.

Kinetic and kinematic data were measured in terms of movement time, displacement, peak velocity, percentage of movement time to peak velocity, and movement units.

Statistical Analysis

A repeated measures ANOVA was used to see if there were differences between the kinetics and kinematics used to reach for the most preferred, least preferred, and neutrally preferred candies. Additionally, one-tailed Wilcoxon Signed Ranks tests for dependent measures were used to compare the differences between the least preferred and the neutrally preferred candies.

Randomization

The order of presentation for each candy bar was organized in a 7 x 7 Latin square design (Table 1) to control for any sequence effects. Each participant was randomly assigned, using

permuted blocks via a computer program, to one of the seven possible order of presentation groups.

The preference questionnaires contained identical items for each of the seven candy types used in the study. However, question orders were randomly assigned according to candy type such that each participant encountered the questions in a different order seven times.

Procedure

This study was approved by The University of Toledo Biomedical Institutional Review Board prior to commencement. All participants gave informed consent at the data collection site before taking part in the study. Data collection occurred from October 2011 through January 2012. Reflective markers were placed on bony landmarks of the participants' dominant upper extremities including the sternum, acromion process, mid-humerus, lateral epicondyle of the humerus, mid-forearm, ulnar styloid process, and the metacarpophalangeal joint of the third digit. Participants were randomly assigned to an order of presentation group and asked to sit at a table. Based on the order of presentation, one of the seven candy types was placed on the table in the participant's line of reach. Participants were asked to place their dominant hand on a Big Red Switch™ (also located on the table) and when the investigator said "go" the participant was instructed to reach for the candy, grasp it, and bring it back to the Big Red Switch™. As participants reached for the candy, motion cameras captured the positions of the markers on their dominant upper extremities. After reaching for each type of candy, participants filled out a corresponding hard copy of a 26 question Likert-type scale to measure the level of meaning as well as its intensity towards the particular candy bar they just encountered. This procedure was repeated until each participant reached for and filled out the questionnaire for all seven types of

candy represented. Each session was approximately 30 minutes long. At the end of the session the participants had the option of keeping the candy they reached for.

Insert Table 1 about here

Results

Forty participants took part in the study. Data from one subject were removed due to instrumentation failure. Data for the remaining 39 participants were reduced using Visual 3D version 4.87 and interpolated using a max gap fill of 10 samples. Data were smoothed using a dual pass Butterworth filter with a cut off frequency of 10 Hz.

Tests of normality and skewness (Kolmogorov-Smirnov, D'Agostino-Pearson, and Shapiro-Wilk) were statistically significant at $\alpha = .05$ for all kinetic and kinematic dependent variables comparing the least and neutrally preferred conditions. This indicated that the data were not normally distributed and therefore needed to be analyzed using non-parametric statistics.

Data from the preference questionnaires were coded and converted into intensity of meaning scores. Only scores from participant's most preferred (scores of 4 or 5), least preferred (scores of 1 or 2), and neutrally preferred (score of 3) candies were analyzed. A detailed comparison between the impact of least (negatively) preferred candies versus neutrally preferred candies was then executed. A concurrent study meanwhile, focused on the scores of the most (positively) preferred candies as compared to the neutrally preferred candies.

The differences in participants' quality of reach movements were analyzed in respect to movement time, movement units, displacement, peak velocity, and percentage of movement time to peak velocity. A *smaller* movement time, displacement, and number of movement units indicate a more efficient movement, whereas a *greater* peak velocity and percentage of movement time to peak velocity indicate a more efficient movement.

A repeated measures ANOVA was used to investigate whether there were differences between the kinetics and kinematics used to reach for the most preferred, least preferred, and neutrally preferred candies. The data analysis revealed a statistically significant difference in performance among the three conditions for peak velocity ($p = .047$) but not for the remaining four variables (Table 2).

A Wilcoxon Signed Rank Test revealed a statistically significant increase in the efficiency of participants reach movements when reaching for their neutrally preferred (compared to their least preferred) candies on the variables of movement time ($p = .0362$), movement units ($p = .0116$), and peak velocity ($p = .0226$). Results for the two remaining variables were not statistically significant ($p = .095$ for displacement, and $p = .359$ for percentage of movement time to peak velocity) (Table 3). Cohen's d was used to calculate the magnitude of these observed effects. According to Cohen (1988), .2 represents a small effect size, .5 represents a medium effect size, and .8 represents a large effect size. A medium effect size of .5 was yielded for movement units, both movement time and peak velocity yielded a small to medium effect size of .3, and displacement yield a small effect size at .2. No effect size was found for percentage of movement time to peak velocity (Table 3).

Hotlix® Insect candy was most frequently rated as the least preferred candy type with 22 of the 40 participants rating it as least preferred (22 responses of a 1 or 2), followed by 15 out of

40 for Twizzlers® Black Licorice. Hershey's® Cookies 'n' Crème was the most frequently neutrally preferred candy type with 25 out of the 40 participants rating it as neutrally preferred (25 responses of a 3), followed by 6 out of 40 for Hershey's® Special Dark. Frequencies of the least and neutrally preferred candies by type can be found in Table 4.

Insert Tables 2, 3 and 4 about here

Discussion

The quality of reach movements when reaching for candies of varying preference levels was examined in this investigation. In the first hypothesis the researchers were interested in whether there was a difference between participants' reach movements when reaching for their most, least, and neutrally preferred candies. A difference between the three preferences was found for one of the five variables measured (peak velocity), offering partial support for this hypothesis. The comparison between varying preference levels is important because previous studies have mostly addressed positively associated occupational forms. However, there is now emerging evidence (see literature review) suggesting that negatively associated occupational forms also have an effect on the quality of one's reach movement.

In accordance with emerging research, the second hypothesis dealt with further exploring the least preferred condition in order to find out whether reaching for negatively associated objects can affect the quality of one's reach movement for those objects. The reach movements for those candies that were self-rated as least preferred were therefore compared to those that were self-rated as neutrally preferred (on the variables of movement time, movement units, peak

velocity, displacement, and percentage of movement time to peak velocity). The researchers found that the quality of reach movement was significantly greater when reaching for neutrally preferred candies in comparison to least preferred candies in terms of movement time, movement units, and peak velocity. This is consistent with the second hypothesis which predicted there would be a difference in the kinematics and kinetics used by participants when reaching for a variety of different candies depending on their preferences for those candies. In this case, participants tended to use more efficient reach strategies when reaching for the candies they neutrally preferred. This was not the case however, on the variables of displacement and percentage of movement time to peak velocity. A statistically significant increase in the quality of reach movement was not found between the two preferences on these variables, and therefore the hypothesis was not supported. This is a similar phenomenon to the results of Rice and Renock (2006) in which no significant differences were found between conditions with regard to displacement and percentage of movement time to peak velocity (and peak velocity). In the current study, although the differences between means were small for displacement and percentage of movement time to peak velocity, they still followed the trend of the remaining variables, with quality of reach movement being slightly more efficient in the neutrally preferred condition. In fact, a small effect size ($d = .2$) was found for displacement, suggesting that a Type II error may have occurred and perhaps a true difference existed between means on this variable.

As far as the variables that were significant (movement time, movement units, and peak velocity), there are many ways to interpret these findings. Least preferred candies may have been less motivating compared to those that were neutrally preferred, causing participants to be more careless in their reach. For example, black licorice was one of the least preferred candies and perhaps participants felt more apathetic towards reaching for this candy than a neutrally

preferred candy such as Hershey's® Cookies 'n' Crème. Some participant's may have experienced fear when reaching for particular candies and the perceived risk associated with these items may have caused them to be more careful (and therefore less efficient) in their reach. This may have been the case with the chocolate covered insects that were rated as the least preferred candy type among the participants. Previous studies of relative risk have indicated that there is a difference in the quality of reach movements when reaching for objects that pose minimal perceived risk compared to parallel objects that pose a greater risk (Rice & Thomas, 2000; Thomas & Rice, 2002; Fuller, Thomas, & Rice, 2006). These studies have established that the efficiency of reach movements decreases when there is a greater perceived risk involved, for example, Rice and Thomas (2000) found that the quality of reach movement was more efficient when participants reached for and poured a pitcher of cold water (low risk situation) versus a pitcher of hot water (high risk situation). This was established for the variables of movement time, displacement, and movement units, two of which (movement time and movement units) were also statistically significant in the current study.

Lastly, other participants may have experienced curiosity with a particular candy type they were less familiar (or experienced) with causing their reach to be less automatic and efficient than a candy type they were more familiar with. Participants may have still been trying to process information or form an opinion about those candy types while they were reaching, rather than being focused on the reaching task itself. This could have potentially drawn mental processes away from the reaching task and reduced the quality of reach movement. Holubar and Rice (2006) have provided evidence for this phenomenon by establishing that when participants reach for their own mug (a familiar object) the efficiency of their reach movement (in terms of

movement time and movement units) is greater than when reaching for the researchers mug (an unfamiliar object) regardless of the context.

In summary there are multiple reasons one might put forward as to why the least preferred candies elicited a less efficient reach movement among participants compared to the neutrally preferred candies. Apathy, fear, unfamiliarity, or negative past experiences are but a few of the factors that might have influenced participants' reach movements, and it is beyond the scope of this study to separate these out. What is certain from the range of responses selected on the preference questionnaires is that the diverse candy types created a spectrum of positive, neutral, and negative occupational forms. Despite the myriad of reasons, the findings suggest that negatively associated occupational forms can quantitatively influence occupational performance. These findings support the outcomes of previous studies that have tested this notion, thus adding to the emerging knowledge base surrounding this topic.

There are multiple ways negatively associated occupational forms can be used in therapy. For example, occupational therapists may incorporate situations that involve fear or relative risk into interventions involving safety awareness. In this case it would be undesirable for a client to use similar kinetics and kinematics when reaching for an object that poses a risk compared to an object that poses little or no risk. Ideally the client would be more cautious during situations involving risk and therefore their movement strategies would (appropriately) be less efficient. These types of interventions may be appropriate for clients with conditions such as traumatic brain injuries in which judgment and reasoning in regards to safety may have been impaired. Another application of this research might involve observing clients' occupational performance during equivalent negatively associated and positively associated occupational forms. This technique may yield useful information about the client's performance during the assessment and

evaluation process. Negatively associated occupational forms are a realistic part of everyday life and it is therefore important for therapists to prepare clients for these situations in addition to more commonly employed positively associated occupational forms.

Limitations of this study are that negative preferences were not subcategorized. Kinetics and kinematics were only analyzed in terms of the general category of “negatively preference”, however it may be presumed that within this category kinetics and kinematics may have varied depending on the reason for the dislike of a particular candy. Also caution must be taken when applying these results to populations other than healthy adults as the findings may not be generalizable to other groups. Another limitation includes the fact that the artificial nature of the lab may have caused participants reach movements to differ from those employed in their natural environment. A final limitation is that the desired N of 77 was not reached and so there was a reduced chance of attaining statistical significance among the dependent variables.

Future research is needed to parse out the different factors that may relegate an object or a situation to being considered a “negative occupational form”, in order to investigate whether occupational performance differs accordingly. It would also be helpful to replicate this study using a larger sample size and with different populations (such as those with traumatic brain injury) to determine whether there is an interaction between health related factors and occupational performance during negatively associated occupational forms. Lastly, a replication of this study in a more naturalistic environment would increase the chance of the results reflecting real world phenomena.

Conclusion

This study examined the effect of intensity of meaning upon the efficiency of a reach movement in healthy adults, while reaching for candies of varying preferences. Preference was

determined by analyzing the survey responses provided by participants in regards to each type of candy involved in the study. It was found that when participants reached for their “least preferred” compared to their “neutrally preferred” candies, kinetics and kinematics were less efficient in terms of movement time, movement units, and peak velocity. In other words the meaning that participants ascribed to the candies ultimately influenced the way in which they reached for them. The results demonstrate that negatively associated occupational forms can influence the quality of participants’ occupational performance. Further research is needed to corroborate these findings in order to support the use of such occupational forms in therapy.

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Appendix

Figure 1

Intensity of Meaning Questionnaire

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I like this object					
I do not prefer this object					
I want to keep this object					
I would choose this object over another one					
I do not value this object					
This object brings back good memories					
I value this object					
I fear this object					
This object comforts me					
I dislike this object					
This object is visually pleasing					
This object brings back bad memories					
I am drawn toward this object					
I would not give this object as a gift					
I love this object					
This object is visually displeasing					
I do not want to keep this object					
I am disgusted by this object					
I prefer this object over another					
This object appeals to me					
I try to avoid this object					
I am delighted by this object					
This object does not appeal to me					
I hate this object					
I would give this object as a gift					
I would not choose this object over another one					

Figure 1: The term “object” refers to any one of the seven candy types used in this study - Hershey’s® Milk Chocolate; Hershey’s® Special Dark; PayDay®; Milk Chocolate Reese’s®; Hotlix® Insect Candy; Hershey’s® Cookies 'n' Crème; and Twizzlers® Black Licorice.

Table 1

Order of presentation of 7 types of candy organized in a 7x7 Latin square

Order of Presentation number	Type of Candy						
<i>1</i>	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>	<i>G</i>
<i>2</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>	<i>G</i>	<i>A</i>
<i>3</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>	<i>G</i>	<i>A</i>	<i>B</i>
<i>4</i>	<i>D</i>	<i>E</i>	<i>F</i>	<i>G</i>	<i>A</i>	<i>B</i>	<i>C</i>
<i>5</i>	<i>E</i>	<i>F</i>	<i>G</i>	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>
<i>6</i>	<i>F</i>	<i>G</i>	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>
<i>7</i>	<i>G</i>	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>

Note. A = Hershey's[®] Milk Chocolate; B = Hershey's[®] Special Dark; C = PayDay[®]; D = Milk Chocolate Reese's[®]; E = Hotlix[®] Insect Candy; F = Hershey's[®] Cookies 'n' Crème; and G = Twizzlers[®] Black Licorice.

Table 2

Multiple Comparisons of Most, Neutral, and Least Preferred Conditions

Dependent Variable	Sum of Squares	dF	Mean Square	F	<i>P</i>
Movement Time	.16	2	.08	2.63	.078
Movement Units	18.67	2	9.33	2.37	.099
Peak Velocity	.06	2	.03	3.19	.047*
Displacement	.002	2	.001	1.57	.215
% of MT to PV	.03	2	.02	2.18	.120

Note. % of MT to PV = Percentage of Movement Time to Peak Velocity.

* Statistically significant at $\alpha = .05$

Table 3

Means, Standard Deviations, Wilcoxon Rank Scores, p-values, and effect sizes for the Least and Neutrally Preferred Conditions

Dependent Variable	Preference	Mean	SD	<i>W</i>	<i>p</i>	<i>d</i>
Movement Time	Least	.82	.23	220	.036*	.3
	Neutral	.75	.19			
Movement Units	Least	3.77	2.0	197	.012*	.5
	Neutral	2.95	1.28			
Peak Velocity	Least	.41	.13	-277	.023*	.3
	Neutral	.45	.17			
Displacement	Least	.37	.04	181	.095	.2
	Neutral	.36	.04			
% of MT to PV	Least	.29	.11	-45	.359	.0
	Neutral	.30	.10			

Note. % of MT to PV = Percentage of Movement Time to Peak Velocity. *Statistically significant at alpha = .05

Table 4

Frequency of Neutrally and Least Preferred Candies by Type

Candy	Neutrally Preferred	Least Preferred
Hershey's [®] Milk Chocolate	2	1
Hershey's [®] Special Dark	6	0
PayDay [®]	4	0
Milk Chocolate Reese's [®]	1	0
Hotlix [®] Insect Candy	2	22
Hershey's [®] Cookies 'n' Crème;	25	2
Twizzlers [®] Black Licorice	0	15

Note. The frequency of preference illustrates how many times each candy was assigned a score of either 1 or 2 (least preferred) or a score of 3 (neutrally preferred).