An Exploratory Study on the Relation between Grasp Types and Bimanual Categories in Manipulation Activities

Joschka Haas†, Mattis Endrikat†, Franziska Krebs and Tamim Asfour

***Abstract*— Understanding the intricacies in bimanual manipulation tasks is crucial for advancements in robotics and especially humanoid robotics. This exploratory study investigates the correlations between grasp type selection and bimanual coordination patterns, referred to as bimanual categories, in human manipulation tasks. To do so, we use two taxonomies: the *Bimanual Manipulation Taxonomy*, which defines categories in bimanual manipulation tasks and the *GRASP Taxonomy*, which defines human grasp types. In our analysis, we use a subset of the *Yale Human Grasping Dataset*, which includes natural, routine activities of housekeepers. The analysis reveals, amongst others, correlations between *Tightly Coupled Symmetric* bimanual coordination and *Power Grasps*. In addition, we identify edge cases such as handling soft and articulated objects, and self-handovers, and provide clear labeling guidelines according to the taxonomy. Soft objects were found to be predominantly handled with *Lateral Pinch* grasps. This study provides an initial step toward a deeper understanding of the relationship between grasp selection and bimanual coordination.**

I. INTRODUCTION

Taxonomies have been widely used to classify grasps in various fields such as medicine, rehabilitation and robotics [1], [2], [3]. The diversity of taxonomies is evident, with specific ones designed for particular use cases such as hook grasps for prosthetics [4], whole-body pose taxonomies [5] and bimanual grasp classifications [6]. Despite the extensive use and development of these taxonomies, there has been relatively little effort to compare them directly. Evaluating taxonomies on equal terms could provide valuable insights into the relationships between different aspects of grasping and manipulation. Understanding these relationships could improve current methods for motion generation and grasp synthesis.

In this paper, we aim to contribute to filling this gap by linking two taxonomies: The *GRASP Taxonomy of Human Grasp Types* [3] and the *Bimanual Manipulation Taxonomy* [6]. The first taxonomy, described in Section III-A, is chosen for its comprehensive description of grasps performed by a single hand, while the second taxonomy, described in Section III-B, is selected for its focus on the coordination patterns between two hands. The goal is to identify correlations between bimanual coordination categories and grasp types. To achieve this, we extend the *Yale Human Grasping Dataset* with labels for bimanual hand coordination, allowing us to explore the usability of the *Bimanual Manipulation Taxonomy* in a real-world setting. Through our analysis, we identify how well this taxonomy works in practice and provide guidance on how to deal with edge cases where the categorization of bimanual activities is not entirely clear.

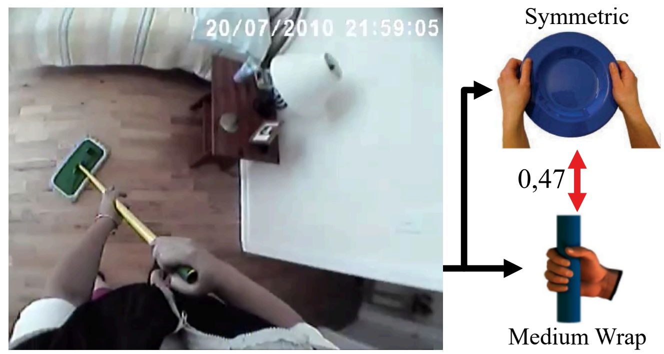

Fig. 1. The existing GRASP labels (e. g., *Medium Wrap*) were extended with categories of the *Bimanual Manipulation Taxonomy* (e. g., *Tightly Coupled Symmetric*). The frame on the left is taken from the *Yale Human Grasping Dataset* [7] and shows a bimanual grasp of a mop, the graphic on the right top is taken from [6], the graphic on the right bottom from [3]. The value in between both pictures shows the found correlation between both categories. This picture serves to illustrate our approach of comparing labels of real world actions from different taxonomies.

It is important to acknowledge that the results of our study are limited by inherent limitations of the subset of the used *Yale Human Grasping Dataset*. Consequently, the generalizable findings regarding the relationship between the two taxonomies are limited in scope. Nevertheless, this study provides valuable preliminary evidence of correlations between grasp types and bimanual categories in everyday living activities. It also serves as a proof of concept, demonstrating the feasibility and potential value of our approach. These initial results lay the groundwork for more comprehensive investigations in the future, which will require larger, more diverse datasets and more sophisticated techniques to further elucidate the complex interplay between unimanual grasp types and bimanual coordination in human manipulation tasks.

II. RELATED WORK

In this section, we review existing human grasp taxonomies and how they are used for human grasp analysis.

A. Human Grasp Taxonomies

Classifying human grasps in grasp taxonomies has been a longstanding area of research [8], [9], [3]. The Kamakura

†The first two authors contributed equally to the work.

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taxonomy [8] defines static grasp patterns based on contact areas shared between the hand and the grasped object. The resulting taxonomy defines 14 grasp types which are divided into four categories: *Power Grip*, *Intermediate Grip*, *Precision Grip* and *Grip Involving No Thumb*. The study of the human grasp selection process by Cutkosky [9] proposes a hierarchical classification of human grasps. In the study, machinists working with metal parts and tools performing small-batch machining tasks were observed. The identified grasp types were categorized in a hierarchical taxonomy tree, mainly differentiating between *Power* and *Precision* grasps and whether the grasps are *Prehensile* or not. In an effort to unify the multitude of existing grasp taxonomies into one uniform taxonomy, the *GRASP Taxonomy of Human Grasp Types* (short: GRASP) compares 22 existing grasp taxonomies and combines their insights into a cohesive new taxonomy [3]. The resulting taxonomy consists of 33 grasp categories, which can be reduced to 17 categories, depending on the required level of detail. The grasp types are divided into *Power*, *Intermediate* and *Precision* grasps, similar to the taxonomy by Kamakura et al. Most of the grasp types proposed by Cutkosky can be found in the reduced set of the GRASP taxonomy.

While this taxonomy provides an accurate classification of single-hand grasps, the interactions between both hands of a human are not addressed. As bimanual coordination is crucial to fully describe human grasps, the *Bimanual Manipulation Taxonomy* [6] was developed to investigate which coordination constraints apply between the hands.

Both the GRASP taxonomy and the *Bimanual Manipulation Taxonomy* are pivotal for this work. We decided to use the GRASP taxonomy for our analysis as it has shown to be an effective method for single-hand grasp categorization in previous studies. The *Bimanual Manipulation Taxonomy*, on the other hand, provides a framework for classifying bimanual actions and enables the investigation of correlations between single-hand grasps and the resulting coordination constraints. A more detailed description of the two taxonomies will follow in Section III.

B. Analysis of Human Grasps

Human grasp taxonomies offer an effective tool to analyze how humans use their hands in everyday life. In previous work, the relations between grasp taxonomy categories and properties of grasped objects have been addressed [10], [11], [12], [13]. Such properties include, for instance, object dimensions, shape, rigidity, and mass. Additionally, correlations between grasp categories and the performed task are investigated. The studies indicate that the identified correlations serve as a feasible heuristic to develop grasp planners [10] as well as to improve the recognition of human grasps [11], [12].

Hand configurations and the respective categorizations can share a high degree of visual similarity. For example, the grasps *Medium Wrap* and *Power Sphere* from the GRASP taxonomy can look very similar in some situations. Consequently, certain grasp categories are prone to misclassification when implementing machine learning algorithms for automatic labeling. In [14], the correlations between grasps, with respect to visual similarity, are derived from the results of automatic visual classifiers. The authors of [15] also present common confusions of grasps in machine learning, and conclude that many such confusions originate from small differences in the hand pose. Additional information on the grasp context can help to counteract misclassification. The relationships between unimanual grasp types and bimanual categories that we investigate in this work may be beneficial for this purpose.

Vergara et al. [16] conducted a detailed analysis of grasp frequency during activities of daily living, focusing on the hand used for each grasp and the respective duration. Their study on right-handed subjects revealed that bimanual grasps occurred 57 % of the time, right-hand grasps occurred 28 % of the time, and left-hand grasps occurred 15 % of the time. The analysis indicated that simultaneous use of both hands resulted in significantly longer grasp duration. However, no significant difference was found in the duration of grasps performed by the right hand compared to those performed by the left hand. The researchers categorized the grasps into nine different types based on the classification system proposed by Edwards et al. [17]. They found that the dominant hand usually performs the grasp that requires more dexterity or force. Apart from this statement, they do not analyze the correlation between the role of a hand within the current bimanual task and the selected grasps.

C. Our Contribution

While significant efforts have been devoted to exploring correlations between categories within a single taxonomy and tasks or objects, the interrelations between two taxonomies remain largely unexplored. In this work, we conduct a preliminary investigation on how grasp choices can be associated with bimanual coordination patterns. Additionally, we evaluate the efficacy of the *Bimanual Manipulation Taxonomy* for annotating real-world data. However, due to limitations stemming from the subset of the used *Yale Human Grasping Dataset*, the findings should not be interpreted as a general rule of bimanual manipulation. Rather, they should be seen as a proof of concept of how the approach can be used to investigate the interplay of the two taxonomies.

III. FUNDAMENTALS

In this work, we analyze the correlations between two taxonomies: The *Bimanual Manipulation Taxonomy* and the *GRASP Taxonomy of Human Grasp Types*. This section will provide an overview of both taxonomies.

A. The GRASP Taxonomy of Human Grasp Types

The GRASP taxonomy considers various aspects of existing grasp taxonomies in order to unify the different approaches to grasp classification into one coherent taxonomy [3]. In the resulting taxonomy, each grasp is classified by grasp type (*Power*, *Intermediate*, *Precision*), opposition type, thumb position and amount of virtual fingers. While

Power Grasps can exert a relatively large amount of force, *Precision Grasps* allow a higher degree of dexterity. *Intermediate* type grasps fall in between these two categories. The opposition type refers to the way fingers and hand parts oppose each other to hold an object, which is further categorized into pad opposition, palm opposition and side opposition. All intermediate grasps in the taxonomy are classified as side opposition grasps. The thumb position is categorized into adducted and abducted thumb. Since humans often use several fingers in a synchronized manner, multiple fingers may be described as one entity for some grasps. These units are described by virtual fingers, which consist of a number of fingers or hand parts. For each grasp type in the taxonomy, the number of virtual fingers required to perform the grasp is given. As the focus lies on static, one-handed grasps, the taxonomy excludes in-hand motion, gravity-depended grasps and bimanual tasks. Figure 2 shows the GRASP categories that are most common in the data that we analyze.

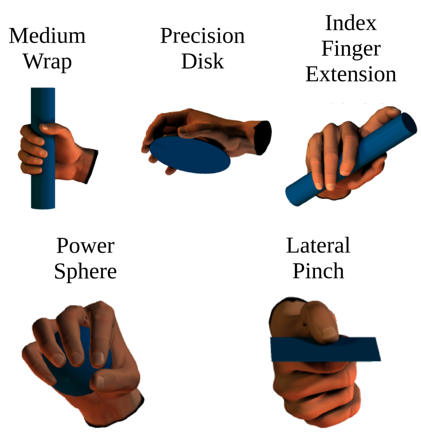

Fig. 2. Grasps from the *GRASP Taxonomy of Human Grasp Types* [3]. These are the grasps most commonly found in the data we use in our analysis.

B. The Bimanual Manipulation Taxonomy

To fully describe how humans manipulate objects, it is necessary to investigate how both hands interact with each other. To address this, the *Bimanual Manipulation Taxonomy* provides a framework for classifying bimanual actions. An overview of the taxonomy is given in Figure 3. Bimanual actions are categorized based on coordination, interaction between the hands, hand role and symmetry. In coordinated actions, both hands perform the task together, whereas in uncoordinated tasks, the hands act independently. Interaction refers to the physical transmission of forces between the two hands, either directly or through objects being held. This is crucial because the interaction forces may determine the successful completion of the task. The hand role, which is relevant in coordinated bimanual tasks, depends on the performed task rather than on the movement of the hands. Tasks can be classified as either symmetric, where both hands have the same role, or as involving a dominant hand. Additionally, some tasks fall into a *Loosely Coupled* category, in which no interaction forces between the hands exist.

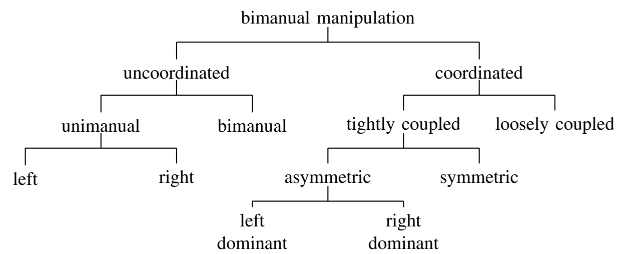

Fig. 3. The *Bimanual Manipulation Taxonomy* presented in [6].

IV. Data Selection and Labeling

This section describes the data we used in our analysis, its labeling as well as the challenges we encountered during data preparation.

A. The Yale Human Grasping Dataset

Our data is sourced entirely from the *Yale Human Grasping Dataset* [7]. Thus, we provide a short description of the dataset. The dataset consists of annotated videos of four people using their hands in everyday situations. In a total of over 27 hours of video material, two housekeepers and two machinists perform regular work activities. The videos are filmed from a first-person perspective via a head-mounted camera. The grasps of the dominant hand of each subject are labeled with the respective grasp category from the GRASP taxonomy. Additionally, every grasped object's estimated dimensions and mass are documented. Further, the current task in which the object is used is documented. The dataset serves as a foundation for an in-depth analysis of human grasping behavior in [10] and [13]. However, the dataset has several limitations. The video resolution is relatively low (640x480 pixels) and the hands sometimes move out of the field of view of the camera, so that the grasp cannot be labeled with certainty. Another limitation is that only the dominant hand, which is the right hand for all subjects, is labeled, while the bimanual categories take account of both hands. This limits the conclusions we can draw from our analysis. Further, the grasps for the right hand are not labeled for every frame; instead, only one label per time step (which varies between seconds and deciseconds) is provided. Therefore, during dynamic motions, grasps might be missed.

B. Data Selection

From the *Yale Human Grasping Dataset*, we used only the housekeeping tasks of the material because the workshop tasks are fairly repetitive, meaning that they utilize fewer different grasps in a given time period. The selection was made with an emphasis on data quality, meaning that both hands are in frame most of the time. The resulting subset of the video material spans more than 60 minutes. To demonstrate that our subset is sufficiently representative of the entire dataset, we compared the frequency and duration of grasps in our subset with the entire data of housekeeper 1

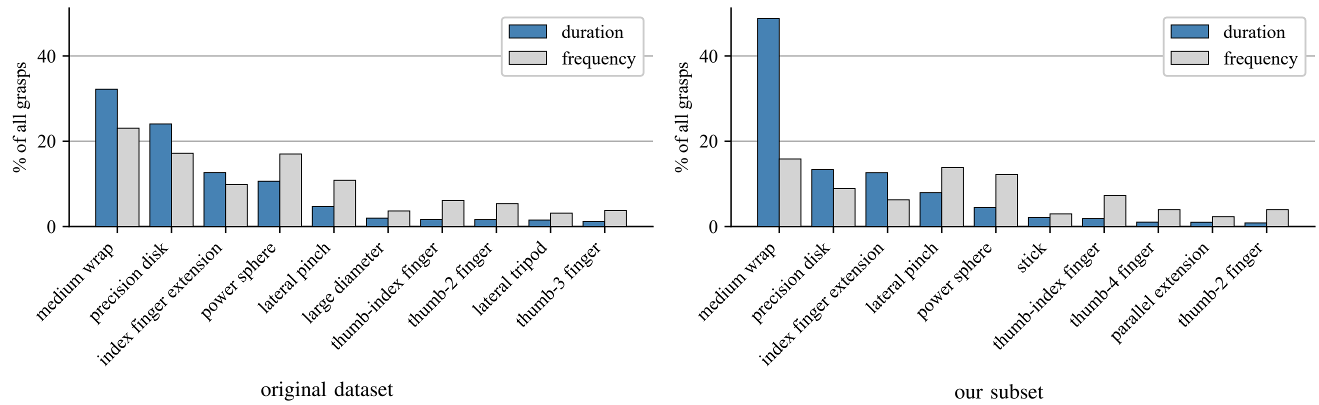

Fig. 4. Comparison of duration and frequency of the 10 most common GRASP categories in our data subset and the entire dataset of housekeeper 1.

in the original dataset. The reason for choosing housekeeper 1 is that almost all of our data stems from housekeeper 1, with only a few further data points from housekeeper 2. Figure 4 shows the comparison of the original dataset and our subset. As can be seen, our subset has a similar distribution of grasps as the original data, sharing the same set of top grasps. The main difference is that our data subset contains significantly longer *Medium Wrap* grasp parts. The reason for this is that our subset includes several segments in which the housekeeper wipes or vacuums the floor, which usually involves a *Medium Wrap* grasp. However, the frequency of grasps remains comparable. We conclude that our dataset is sufficiently representative of the original data.

C. Labeling Bimanual Categories in Real-World Data

In order to compare GRASP labels and bimanual categories, the selected data is labeled with the bimanual categories proposed in [6]. This is particularly noteworthy as it is the first analysis of completely unconstrained actions performed outside of a laboratory setting in the context of bimanual coordination patterns. Using a modified version of the *action-labeller* tool[1], developed in the context of bimanual action recognition [18], we manually labeled the selected subset of the *Yale Human Grasping Dataset* with bimanual categories. For the majority of the dataset, the performed actions could be clearly assigned to a specific category. However, during labeling we came upon these three types of edge cases, which could not clearly be assigned to an existing category:

- *Soft materials:* Handling soft materials, such as cloths or garments, proved difficult to categorize because they provide no clear force coupling, even though both hands move in a way that is indicative of coupled grasps, i. e., both hands touching the same object.
- *Articulated objects:* Contrary to rigid objects, articulated objects have a joint-like structure that allows the movement of individual interconnected parts, like coin purses or floor wipers. When grasped, the hands often move in a way that indicates a *Tightly Coupled Symmetric* grasp. However, since the objects are free to move or rotate on at least one axis, they cannot be easily classified as such.
- *Self-handovers:* To pass objects from one hand to the other, objects are often thrown rather than passed from hand to hand. This means that there is a short moment during which neither hand has contact with the object.

Figure 5 shows examples of those three edge cases in the dataset, which we will discuss in more depth in Section V.

[1] https://git.h2t.iar.kit.edu/sw/bimanual-actions/action-labeller

V. Analysis of the Edge Cases

We conducted a more in-depth analysis of the edge cases (*soft materials*, *articulated objects* and *self-handovers*) that were identified while applying the *Bimanual Manipulation Taxonomy* on real-world data as described in Section IV-C. For these cases, the current definitions of the categories seemed inconclusive during labeling, which should be avoided in order to facilitate reproducible category assignments. It should be noted that the edge cases were identified during the labeling process. They represent categories of situations where bimanual annotation was not entirely clear during the manual labeling process. The analysis of these edge cases does not include a quantitative analysis, as that was not the goal of this work.

A. Soft Materials

When interacting with soft materials, such as cloths or garments, force coupling between the hands is not necessarily present, even though both hands may grasp the same object. Bimanual grasps on soft materials should be labeled as *Loosely Coupled* when there is no direct force coupling. Although the constraints on these types of grasps are stronger than stated in [6], the hands can still move largely uninhibited, adhering only to temporal and spatial via-points within the constraints of the grasped object. Conversely, when direct force coupling is present (i. e., the fabric is pulled taut), the grasps should be categorized as *Tightly Coupled Symmetric*, in accordance with the original taxonomy. In this paper, we specifically consider the bimanual handling of soft objects, leading us to introduce a separate category termed *Coupled Soft*. This category is used solely for the purposes of this study and is not intended to be an extension of the *Bimanual Manipulation Taxonomy*.

Soft Material | Articulated Object | Self-Handover

Fig. 5. Examples of bimanual edge cases for the classification of bimanual categories in the *Yale Human Grasping Dataset* [7].

B. Articulated Objects

According to the *Bimanual Manipulation Taxonomy*, bimanual grasps on articulated objects should be classified as *Tightly Coupled Symmetric* if the hands have similar roles. If one hand has a primarily supporting role, the grasp should instead be labeled as *Left Dominant* or *Right Dominant*. Such classification is consistent with the taxonomy as *Tightly Coupled Symmetric* grasps do not necessarily imply a fixed transformation between the hands, although this is often the case. Nevertheless, articulated objects present a more complex challenge for extracting coordination constraints between the hands due to the kinematic constraints they impose.

C. Self-Handovers

According to the taxonomy, self-handovers should be classified as *Loosely Coupled* during the approach phase. When both hands make contact, the classification should switch to *Tightly Coupled Symmetric*. The ambiguity in self-handovers primarily arises in dynamic scenarios where the object is thrown and thus not in contact with either hand for a period of time. In such cases, the label should remain as *Loosely Coupled* during the time in the air.

VI. Correlation Analysis

In this section, we present the analysis of the combined dataset that contains labels for both the GRASP and the *Bimanual Manipulation Taxonomy*. We analyze the data both in terms of correlations between the exact grasp types and bimanual categories, as well as between subgroups. All the relations described here were also checked for plausibility via a sample analysis.

A. Power, Intermediate and Precision Grasps

As a first step, we analyze correlations on a coarser level by using only the highest hierarchy level of the GRASP taxonomy [3]. This includes the *Power* and *Precision Grasps* (see [19]) as well as *Intermediate Grasps*. In our analysis, we add the category *No Grasp* to cover the entire dataset. The results are illustrated in the heatmap in Figure 6. Dark red colors indicate a strong positive correlation, dark blue colors indicate a strong negative correlation and light colors signal a weak correlation. The histograms positioned along the edges of the correlation matrix illustrate the distribution of duration for each grasp type within the dataset. Figure 7 shows examples for common combinations in our dataset.

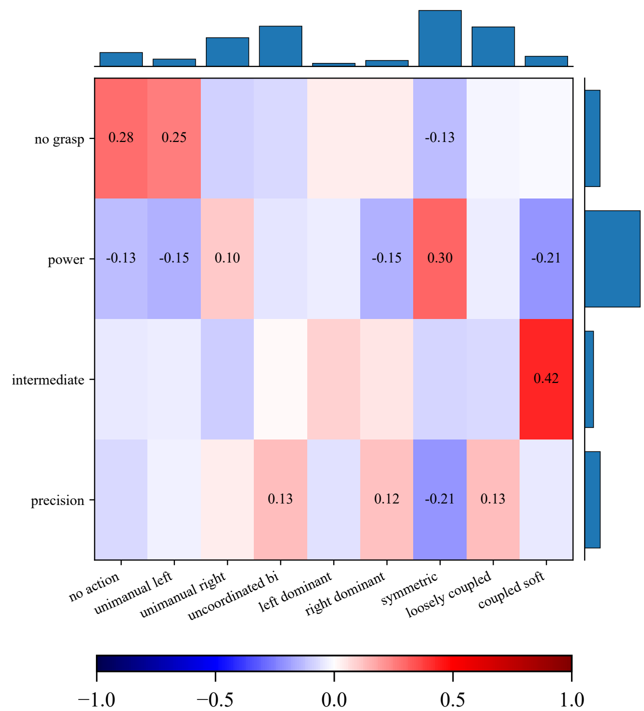

Fig. 6. Heatmap of correlation between *Power*, *Intermediate*, *Precision*, *No Grasp* and bimanual categories with histograms showing the accumulated duration. Only correlations with an absolute value of 0.1 or higher are shown.

1) No Grasp and No Action/Unimanual Left: It was expected that there would be a correlation between the GRASP *No Grasp* and the bimanual *No Action* label. Since only the right hand of both subjects, housekeeper 1 and 2, is annotated with GRASP labels, and the right hand does not perform any grasps in *Unimanual Left* manipulation, there is also a correlation between *No Grasp* and *Unimanual Left*. The minimal correlations observed between the *No Grasp* category and other bimanual categories are attributed to the differing temporal resolution of both datasets.

2) Power Grasps and Tightly Coupled Symmetric: Our analysis revealed a correlation between *Power Grasps* and the *Tightly Coupled Symmetric* bimanual category. This correlation is particularly driven by *Medium Wrap* grasps. In the

Power Grasps and Tightly Coupled Symmetric | Precision Grasps and Loosely Coupled | Precision Grasps and Uncoordinated Bimanual

Fig. 7. Examples of common combinations of the highest hierarchy level of the *GRASP Taxonomy of Human Grasp Types* and categories from the *Bimanual Maniupulation Taxonomy* in the *Yale Human Grasping Dataset* [7].

majority of situations in which *Tightly Coupled Symmetric* grasps are performed, subjects were observed holding a mop or a comparable rigid object with both hands.

3) Precision Grasps and Loosely Coupled: Loosely Coupled grasps mainly occur when both hands interact with one or more objects during manipulation, for example when counting money or during the approach phase of a self-handover. Additionally, situations in which the subject uses one hand to manipulate an object and the other hand to support themselves are labeled as *Loosely Coupled*. In such poses, the majority of grasps performed by the non-supporting hand, given that it is the dominant hand, are *Precision Grasps*. This further contributes to the correlation between *Precision Grasps* and *Loosely Coupled* actions. We cannot draw conclusions about cases in which the non-supporting hand is non-dominant, as the non-dominant hand is not annotated.

4) Precision Grasps and Uncoordinated Bimanual: In most instances of *Uncoordinated Bimanual* actions, the subject holds an object with one hand while performing a more dexterous task with the other. When the dominant hand performs the dexterous task, it often uses a *Precision Grasp*. This finding is similar to that of the previously described support poses, as one hand performs a simple action, such as holding an object or providing support, while the other hand predominantly performs a *Precision Grasp*. As mentioned above, no definitive conclusions can be drawn when the non-dominant hand performs the dexterous task. This is due to the lack of annotation for the non-dominant hand in the dataset.

5) Intermediate Grasps and Coupled Soft: The *Coupled Soft* category was introduced to denote situations in which a soft object is manipulated by both hands without force coupling. Such grasps are commonly characterized by the use of *Lateral Pinch* grasps, for example when folding clothes, tying a knot or handling bed sheets. Since *Lateral Pinch* is an *Intermediate Grasp*, our analysis shows a correlation between *Intermediate Grasps* and the *Coupled Soft* category.

B. GRASP Types

This subsection examines the correlation between categories of the GRASP taxonomy and bimanual categories, focusing on cases not previously covered in subsection VI-A or cases that are exceptions to the results. The data is displayed in the heatmap in Figure 8. As before, dark red

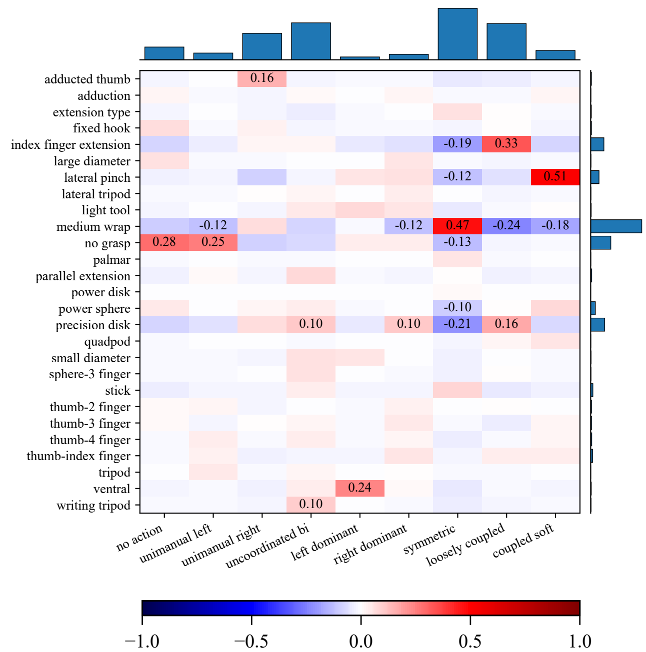

Fig. 8. Heatmap of correlation between GRASP types and bimanual categories with histograms showing the accumulated duration. Only correlations with an absolute value of 0.1 or higher are indicated.

colors imply a strong positive correlation, while dark blue colors imply a strong negative correlation. The histograms on the edges show the accumulated duration of the grasps in the dataset.

1) Ventral and Dominant Left: The *Dominant Left* bimanual category occurs very rarely in the dataset. In most instances of this category, the subject is engaged in garment arrangement tasks, typically holding the hanger with the right hand and performing a *Ventral* grasp. Consequently, a relatively high correlation coefficient is observed between the bimanual *Dominant Left* category and the GRASP *Ventral* category. However, this correlation primarily stems from a singular scenario within the dataset.

2) Index Finger Extension and Loosely Coupled: In contrast to the general correlation between *Loosely Coupled* manipulation and *Precision Grasps*, there is a relatively high correlation between *Index Finger Extension* grasps, which are *Power* type grasps, and the *Loosely Coupled* category. This can be attributed to the particular way one of the housekeepers uses their hands while vacuuming: The right hand is used to hold the vacuum cleaner with an *Index Finger Extension* grasp while the left hand holds the cable of the vacuum cleaner. This constellation is labeled as *Loosely Coupled* since there is no direct force coupling, no symmetry, and no dominant hand, yet both grasps depend on each other.

VII. DISCUSSION

In this section, we discuss our findings, contextualize them within the existing literature, and address the limitations of our analysis.

Our analysis in Section VI showed a significant correlation between *Power Grasps* and the *Tightly Coupled Symmetric* category. Contextualizing these findings with previous research, this correlation can be attributed to the specific way in which humans handle heavy objects. Heavier objects promote the choice of a bimanual transport strategy (corresponding to *Tightly Coupled Symmetric*) [20]. Other works investigating the factors that influence grasp selection suggest that a *Power Grasp* is more likely for heavier objects [10]. Therefore, object weight emerges as a potential causal factor underlying both the *Tightly Coupled Symmetric* category and *Power Grasps*.

We labeled situations in which the subject uses one hand to support themselves while the other hand performs another action as *Loosely Coupled*. We found that in most of these cases the non-supporting hand performs a *Precision Grasp*. This may indicate that, due to balance reasons, support poses imply a preference for grasps that require only comparatively little force from the dominant hand.

In the context of this work, we considered the category *Coupled Soft* in addition to the categories of the *Bimanual Manipulation Taxonomy*. The majority of the actions labeled as *Coupled Soft* do not show direct force coupling between the hands, and thus fall into the *Loosely Coupled* category of the original bimanual taxonomy. Yet, there are clear differences between the two labels in terms of correlations with the grasp type, such as the high correlation between *Coupled Soft* and *Lateral Pinch* grasps. This shows that the *Loosely Coupled* category covers a variety of different grasps, and that the specific hand configuration of each hand is highly dependent on the action performed.

The main limitation of our analysis is the data we used. Only labels for the right hand were available in this data. This significantly complicates the consideration of jointly executed grasps. Such an investigation would be particularly relevant for the asymmetric categories. In general, the dataset could be larger and include more subjects or broader everyday scenarios. In Section VI-B in particular, general statements can only be made to a limited extent, as some categories occur only rarely or only for specific actions.

VIII. CONCLUSIONS

This study provides labels based on the *Bimanual Manipulation Taxonomy* for a subset of the *Yale Human Grasping Dataset* that includes natural, regular work activities of housekeepers. Through our analysis, we identified edge cases such as handling soft and articulated objects, as well as self-handovers, and provided clear guidelines on how these should be labeled according to the taxonomy. A comparative analysis of bimanual categories and grasp types according to the *GRASP Taxonomy of Human Grasp Types* revealed correlations between *Tightly Coupled Symmetric* coordination and *Power Grasps*. In addition, the separate consideration of handling soft objects revealed that, within our dataset, these are most commonly handled with *Lateral Pinch* grasps. Our findings contribute to an initial understanding of grasp selection in bimanual manipulation scenarios. Future research should extend these results by examining a larger dataset, including more subjects, and exploring additional everyday scenarios, such as cooking. To improve the quality of the results, it will also be necessary to label grasps for both hands and to achieve a better temporal resolution of the labels.

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